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To Advertisers

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than Monday noon to insure publication in that week's issue.

The serial article entitled "The Construction of Small Telephone Exchanges," by Mr. A. E. Dobbs, now appearing in the ELECTRICAL REVIEW, should prove of great value to those engaged in telephone work. The literature of the telephone is exceedingly meager, and there has been practically no authoritative writing on the subject of the construction of small exchanges. It is believed that this series of articles will give the information that is desired by many individuals and corporations who are thinking of starting telephone enterprises in many parts of the country. Written from the standpoint of the practical man, and for his particular benefit, these contributions are of unusual interest and value.

THE AUTOMOBILE INDUSTRY.

On other pages of this issue of the ELECTRICAL REVIEW are presented a series of articles dealing with the automobile situation as it is to-day, and describing the various types of automobile vehicles now upon the American market. The natural interest felt by many electrical people in automobiles of types other than those propelled by electricity has counseled the inclusion of descriptions of vehicles operated by steam and internal-combustion motors. The development of the electrical vehicle has been astonishing when it is considered how many and how serious were the difficulties that beset its earlier career. In the first place, all the traditions of the carriage builder's art had crystallized around types of vehicles drawn by outside power and not propelled by power contained within themselves. Here, then, was necessitated at the beginning a radical departure in running gear and frames, along with which was the necessity for a reasonable adherence to forms of vehicles familiar to the public eye. Some of the results of this struggle between conservatism and necessity are still evident in automobile designs.

Another difficulty which beset the early experimenters was the absence of experience regarding electric motors for what is practically railway service. This has now been abundantly obtained in street railway practice, and methods of control carefully developed in that field have been adopted by the automobilists with great success. But the essential trouble, and the one that has lingered longest in the history of the vehicle, was that the storage battery—admirable, excellent and efficient invention as it has proven itself to be when it can be set up firmly on a solid foundation and carefully watched—was too delicate an apparatus to stand the hauling and bumping necessarily involved in vehicle travel. The genius of a generation of inventors has been applied to the betterment of the storage battery, and really astonishing results have been achieved when it is considered that there has been no basic variation in the design of the battery for twenty years. The same elements still enter into its composition; all the improvements that have been obtained have been the result of better methods of construction, better methods of mechanical design, and experience in the use and operation of accumulators.

That the future must hold a perfected design of storage battery is something that no one can safely deny in the light of electrical experience in other directions. When that day comes, the electric automobile will unquestionably supersede the horse for all forms of vehicular transport in cities, and doubtless to a considerable extent in suburban and country districts also. This seems a foregone conclusion from which there is no escape, and a little speculation as to what this would mean in the city of the future seems pardonable in view of the almost complete certainty of the event.

The suppression of the horse, doing away at one stroke with all of the dirt and ninety per cent of the noise of our streets, would work a slow but genuine revolution in the condition of cities and indirectly exert a powerful effect upon commercial conditions as well as the merely physical aspect of the towns and the people in them. The sanitary condition of horseless cities, having impervious pavements, could be made practically perfect. Perhaps the future will see electricity accomplishing, through the automobile vehicle, as great a work for the dwellers in towns as it has already done through the electric street car. If this be so, then the exploiters of the electric carriage have just claim to a high place in the remembrance of their descendants.

This is the season of the year when all sorts of outdoor construction work is resumed and when the electrical contractor begins to be busy with his Summer work. The outlook for general electrical business in this country this Summer is probably better than it has ever been before. There is in progress a considerable amount of street railway building and a number of important enterprises will be undertaken in various parts of the country. The exploitation of water-power plants within the last few years has taken a great impetus and several large installations have been planned for construction this Summer. Electric light lines will also undergo considerable alteration and extension during the Summer and Autumn in preparation for the rush of work during the dark days of next Winter. The whole outlook is so cheerful and promising that it seems proper to say a few words of congratulation at the beginning of the season of active work.

It is astonishing to note the number of new activities with which the electrician is concerned to-day. Not so very many years ago telegraph apparatus absorbed all his energies, but since the invention of the dynamo and the introduction of electric lighting and electric-power transmission, a host of new applications of electricity has arisen and among them several which promise wide development in the early future. Perhaps no other branch of electrical work is so full of this promise as the application of electricity to chemical reactions of various kinds. The arts of electrochemistry are as yet at their beginnings, but the rate of progress which has been established leads inevitably to the belief that in this direction electricity will find one of its most useful applications. In a few years the electrical method of refining copper has practically superseded all others. Similarly, in many departments of the chemical industry electrical methods regarded as laboratory experiments a few years ago are now practised on gigantic scales with resulting profit and satisfaction. Leaving out of account the new products which electrochemistry has given to the world, such as carbides and aluminum, the application of electricity to such old and well-known industries as the manufacture of bleaching powder and caustic soda, the refining of copper and the production of chlorate of potash, has given an entirely new life to these industries and to those dependent upon them. At present it is fair to say that only the outlying regions of the electrochemical domain have been explored and it is certain that rich prizes await the investigators who will be the pioneers in this new direction of electrical expansion.

The New York *Times* is still somewhat unsatisfied about our position concerning electrical execution, but it is beginning to see the light. In a recent issue commenting on the apparently sentimental reasons that cause electrical execution to be regarded with hostility by electrical men it states:

"The people of this State adopted the electrical system of execution because they thought it was quick, humane, and as free as possible from repulsive features. They certainly do not want even the worst of their criminals shocked into temporary unconsciousness and then cut up alive by inquisitive doctors. The moment the electricians prove to the general satisfaction that any such thing as that is going on, the system will be changed."

This is precisely what we have asked for. If there is any reasonable doubt that a criminal is alive after the electric current has been applied to him the subject should be fully and thoroughly tested by a committee of experts without bias and the legislature should be prepared to stand by the result. If it can be proved after scientific and proper investigation that electricity does the killing, then electrical men can have no fair reason to object to this method of execution. If, as we contend, it is even *possible* for the killing to be done by the autopsy and not by the current, then all fair-minded men must regard the whole method as one too repulsive to endure and one that should be superseded by a more certain and humane variety of execution.

It has just been announced that the Metropolitan Street Railway Company, of New York city, will soon change over its existing cable lines to electricity, thus making all of the main-line traffic of its great system in Manhattan electrical. Other important changes in the system will also be made so that certain ferries on the West Side may be more easily accessible. While this change will accomplish much for the company in reducing expenses of operation and in unifying the system, still electrical engineers should not forget that this corporation has performed a most valuable service for them and for their art by the thoroughness, the boldness and the skillful management with which it has undertaken the enormous problem of electrical operation of its lines in New York city. These lines have been the theatre of experiments of the utmost value to the art in general and the results attained have been given with great liberality to the public.

The Pan-American Exposition will soon open at Buffalo, and advance reports indicate that it will be exceedingly interesting as a general gathering of exhibits and most particularly valuable as an electrical exposition of the first class. The city of Buffalo is well situated in regard to what may be called its electrical facilities, and electric light and power will be abundant at the exposition grounds. Probably no finer object lesson could be found in the world for the admiration of visiting foreigners than the Niagara transmission and the great generating and receiving plants incident to it. The electrical industries gathered at Niagara Falls will form a sort of annex to the exposition little less interesting than the exhibits gathered in the ground themselves. Of these latter there will be many of high interest, embodying in some cases features of novelty not hitherto exhibited. The larger manufacturing companies have contributed liberally toward the placing of exhibits fully showing their industries and an assured success seems to be waiting for the opening of the doors of the exposition on May 1.

An encouraging sign of the times is the frequent incorporation of small electric lighting companies, especially in the towns of the Middle West. This is not only an evidence of prosperity, but of the continuing popularity of electric lighting in the face of strong competition from gas and gasoline lighting.

A QUESTION OF SPEED.

A report is extant that a young gentleman, who can afford it, wants an automobile which will have a minimum speed of seventy miles an hour.

The success of any industry or commerce depends largely upon its adaptability to the uses of the public at large, and not to the whimsy demands of a few persons. Several years ago bicycles were built for pleasure purposes, and were correspondingly heavy. Soon the builders began to turn out spidery affairs which it was impossible to run over an ordinary pavement, much less over uneven cobblestones. The frailty of these machines injured the trade, and the racing bicycle was a serious blow to the industry.

It is hardly likely that racing automobiles will ever prove so disastrous to their field as the racing bicycle proved to its manufacturers. It is, however, not to be doubted that the faster automobiles are made the less demand there will be for them, the fewer people will purchase them and that the trade at large will receive a considerable setback. What is desired in the practical vehicle is a modicum of speed and lightness with a maximum of comfort and safety. The racing machine, being designed particularly for speeding purposes, is not comfortable to ride in nor good to look at. A certain machine which is noted for its rapid traveling has a peculiar motion in starting which resembles most nearly the jump of a person who sits suddenly and unexpectedly upon a sharp projection—undignified at the least. The frailty of such machines is another very serious drawback to their general use, and the prices asked for them are prohibitive to the vast majority of people of ordinary means who could afford to buy a lower-priced machine. If the manufacturer desires his product widely used and wishes to see the people at large enjoying the result of his manufacturing ability, he must make a machine which will stand wear and tear, which will suffice in speed for persons of sound mind and reasonable intentions, and he must sell it for a price which will net him a fair return. The seventy-mile an hour machine is a ridiculous proposition. Any one who has ever traveled twenty or thirty miles an hour in an automobile is not likely to care for any seventy-mile performance. Such a machine could run from New York to Buffalo in the same time as the Empire State Express, provided a track were obtainable for it; but if seventy miles is the minimum, where would the famous express train be if the *chauffeur* threw his lever to the last notch?

TROLLEY LINE CONSOLIDATIONS.

All over the country the consolidation of trolley railways and systems is progressing rapidly and the present outlook is that this Spring and Summer will see much further progress in this direction and the combination under single managements of many electric railway lines now disconnected.

Without going into the causes which lead to this state of things it is extremely interesting to note the tendency of the movement, and the result that sooner or later it will bring about. Already a map of the eastern states, showing the electric railways, exhibits that continuous lines exist between many points of importance, separated often some hundreds of miles. Indeed, the New England states and the Middle West are practically covered with a network of trolley lines equal in extent to that of the steam railroads. So long as these various lines are operated as disconnected systems for the transportation of passengers only their effect will be merely to gather to themselves the short-haul passenger business of their respective districts. But once consolidated and operated under conditions that will permit freight to be carried also, it seems evident that these networks must soon grow into active competitors of the steam railroad lines in their vicinity.

Thus, while the discussion concerning electrifying steam railroads has been going on for several years there has been growing up, paralleling the steam railways, a system of light railroads electrically operated and which, by the natural logic of events, is rapidly becoming an important competitor. The public has nothing to lose by this state of things but rather very much to gain, since the trolley line has given it already an effective duplication of railway facilities; and the period of competition which may reasonably be looked for in the near future will doubtless result in a considerable increase and betterment of these. The situation is one that is exceedingly interesting, and while it is unsafe to look too far into the future, still it is reasonably evident that we must soon see lines as long as from New York to Boston or New York to Philadelphia merged under single managements and competing for through business between such points.

WATERFALLS AS CENTRES OF INDUSTRY.

Within a very short time two important installations of electric power-transmission plants have been installed at waterfalls, one at Niagara and the other at Snoqualmie. Primarily, the object of the plants is to transmit electrical energy to cities at a distance where it may be utilized for various commercial purposes, but it now seems that a new phase is being manifested. A few days ago an electrolytic refining company, having a plant in the vicinity of Niagara, contracted for a heavy increase in the horse-power furnished it by the power plant, and will extend its works at a cost of nearly a million dollars. This may be taken easily to indicate that the great power-transmission plants which are located at waterfalls throughout the country will soon become large centres of manufacture. Real estate in the cities is expensive and often unsatisfactory, but in the country land is much cheaper, and, with ordinary railroad or water transportation facilities, great industries are locating at the various power plants and erecting factories which will operate at less expense, producing the same, or better, results than they could in the more crowded cities.

The water powers of the South—which, until now, have been little heeded—are slowly coming to the front and within a few years we shall see a number of plants similar to the Niagara or Snoqualmie stations operating throughout the southern part of the United States, surrounded on every side by busy and prosperous factories whose output will be limited only by the demand made upon them by the open markets of the world.

Science Brevities

Voltameter as an Ammeter—It has been pointed out by M. André Job, before a French Chemical Society, that an ordinary voltameter, in which water is electrolyzed and the mixed oxygen and hydrogen collected, can be used as an amperemeter if it be fitted with a long capillary exit tube and a water manometer, since the excess of pressure is proportional to the rate of the evolution of gas, and therefore also to the intensity of the current at the time.

X-Rays in Chemical Analysis—The following abstract appears in *Lightning*: M. G. Sagnac in a recent publication, shows how the electric action of the secondary rays emitted by a body can detect the presence of minute quantities of relatively active elements, such as copper, iron and aluminum, and can be made a means of searching for new elements. The energetic absorption of the more active rays from such a metal as platinum in the first few millimetres of adjacent air has been verified directly by rarefying the air surrounding the metal. Finally a pencil of Rœntgen rays discharges a conductor even when it does not pass through the portion of the air acted on by the electric field of the conductor. It is sufficient that the rays shall traverse a portion of air separated from the field of the conductor by a Faraday screen, such as metal gauze, and that there shall be a field of force in the part traversed of like sense to that due to the conductor. If the charge of the conductor is reversed in sign, the rate of discharge is altered in the ratio of 1 to 10 or 20, but in the absence of the field in the second region no such change takes place. M. Sagnac's explanation is that the ions produced in the second region acquire, under the influence of the external field, sufficient kinetic energy to carry them through the openings of the screen into the region surrounding the conductor.

Velocity of Ions—In an article on this subject in the *Physical Review*, Mr. C. D. Child adopts a new method for determining the velocity of ions in a gas which was suggested by Professor J. J. Thomson, says a British contemporary. A test was made by applying this method to the determination of the velocity of ions produced by a flame. The author points out that no attempt has been made to secure great accuracy, since the quantity to be measured—*i. e.*, the velocity of the ions—is one depending on a great variety of conditions, and because this work is rather the test of a method than anything else. The accuracy of the result given, however, will compare favorably with those hitherto secured in attempting to measure such velocities. There was considerable objection to determining the potential with a wire, and accordingly a water dropper was used in the test carried out by the author. In the first place, application of the method suggested by Professor Thomson showed that the velocity of the positive ions drawn from a Bunsen burner is approximately 2.2 centimetres per second for a potential gradient of one volt per centimetre, and that for negative ions 2.6 centimetres. In the case of an unlimited supply of ions, if the discharge takes place between two regular surfaces, the velocity may be determined by simply measuring the current per unit area and the difference of potential between these surfaces; and if the surfaces be not at all regular, the relative velocities of the positive and negative ions may be determined by comparing the positive and negative currents.

Wireless Telephony—The evolution of the wireless telephone is making rapid strides in the hands of the German physicists. Herr E. Ruhmer, whose ingenuity seems to know no bounds, has modified both the transmitter and the receiver in a radical manner, says one of Mr. Fournier d'Albe's abstracts. After pointing out that a small current intensity in the "speaking arc" is bad for acoustic effects, but very good for the fluctuations of luminous intensity used for transmission, he proceeds to dispense with the arc altogether, and substitutes for it a chalk or zircon block mounted on the telephone diaphragm itself and heated in the usual way by means of an oxy-hydrogen flame. The slight vibrations of the telephone disk suffice to alter the position of the luminous body in the flame, and thus to vary its luminosity in a manner suitable for the transmission of speech. At the receiving station, the high resistance of selenium cells has hitherto presented a difficulty. The author gets rid of it by substituting for the selenium cell a "radiomicrophone," a kind of carbon coherer mounted in the focal line of a parabolic mirror. The differences in temperature produced by the impact of the light upon the carbon are sufficient to actuate a telephone receiver. The author also suggests a bolometer as a receiver.

Allotropic Silver—M. Berthelot has paid particular attention to the determination of the calorific values of elements in their different allotropic modifications, having among others ascertained the heats of combustion of the different varieties of carbon, whether as an amorphous body, as graphite or as diamond. The difference is considerable. In his latest work M. Berthelot claims to have detected no less than four different varieties of silver. His experiments were made by dissolving two grammes of finely divided silver in a large mass of mercury contained in a calorimeter and noting the heat generated. With pure silver foil the liberation of heat was at the rate of 2.03 calories per 108 grammes of silver. When a portion of the same foil was disaggregated by heating it to 550 degrees centigrade in an atmosphere of oxygen, and then dissolved, the heat produced fell to 0.47 calorie per 108 grammes of metal. With crystals of silver precipitated by electrolysis from silver nitrate the corresponding figure was 0.10 calorie. If, however, the crystals were obtained by precipitation from silver nitrate by metallic copper, and dried at ordinary temperatures before dissolution in the mercury, the heat produced was 1.19 calories per 108 grammes of the metal dissolved.

Electrolytic Proof Silver—Proof silver is prepared in the United States Mint by subjecting fine silver (0.999) to electrolysis, using an electrolyte of silver nitrate with one per cent of free nitric acid. The bar of fine silver is carefully wrapped in filter paper and all enveloped in cotton cloth, so as perfectly to retain the impurities, such as peroxide of lead, etc., which accumulate as the bar is dissolved. The bar so protected is connected with the positive pole of the battery or other source of electricity, thus becoming the anode, while the cathode is formed by connecting a sheet of chemically pure silver to the negative pole. The silver is thrown down as crystals, which are easily washed. In this way pure silver, even in large quantities, can be easily prepared. In melting the crystals the same flux is used as in the case of gold—three parts fused borax and one part pure niter—but it is necessary to melt the bar a second time. The second melting is made without flux, and is for the purpose of removing the oxygen introduced by the niter of the flux. When the silver is perfectly melted, it is stirred with a piece of dry wood as long as the action due to the presence of oxygen continues. When this subsides, the silver is poured into a chalk-lined mould. The bar is cleaned with a brush and dilute sulphuric acid. After being rolled out, it is ready for use.

THE THEORY OF ALTERNATING DYNAMO ELECTRIC MECHANISMS—XXIII.

BY W. ELWELL GOLDSBOROUGH.

ON VARIABLE RESISTANCE IN PARALLEL CIRCUITS.

Take, for example, such a circuit as that shown in Fig. 68. Here the circuit O_1A_1 is in parallel with the circuit O_2A_2, and this parallel system is supplied with power from the alternator E. The circuit O_2A_2 is a non-inductive one, containing only the *variable* resistance r_2. The circuit O_1A_1 has a *constant* impedance due to the inductance L_1 and the resistance r_1.

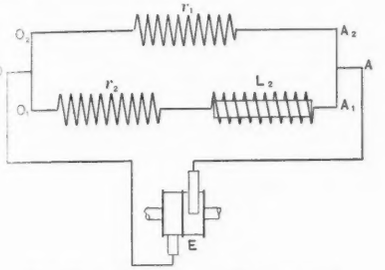


FIG. 68.—ALTERNATING MECHANISMS.

If we assume that initially r_2 has a very high value the circuit O_2A_2 can be neglected, as the current I_2 in the circuit will be infinitesimally small. Under these conditions the current flowing in the circuit O_1A_1 will be the only one apparent in the system, and so I_1 will equal I. The latter current is represented in Fig. 69 as the vector OB_1, and OA is the impressed electro-motive force.

Suppose now that r_2 is decreased. A current will immediately appear in the circuit O_2A_2, which will be in phase with the impressed electro-motive force E. As r_2 continues to be reduced this current I_2 will finally reach a value OB_2. In this event, as I_1 is a constant, the resultant current flowing in the system will be the resultant of OB_1 and OB_2, or OB. As, therefore, r_2 is still further reduced, and I_2 increases in the direction OA, I also continues to increase, the locus of its vector head being the line B_1B, extending indefinitely in a direction parallel to OA. The greater I_2 becomes the greater is the value of I, but, since I_1 is fixed in value, I_2 approaches nearer and nearer the value of I as r_2 is diminished, until in the limiting case I_2 and I are equal and in phase.

The effect, then, of a reduction in r_2 is to reduce the value of the angle of lag of the main current behind the impressed electro-motive force. The law of the variation of the current is, however, markedly different from the cases previously considered. In these the loci have all been parts of circles.

Fig. 69 graphically represents the equation

$$I = E\sqrt{(g_1 + g_2)^2 + b_1^2} \quad (189)$$

in which E, g_1 and b_1 are constants and g_2 is a variable. For by equation (165), page 272, it is shown that in an alternating-current circuit the *current is equal to the product of the impressed electro-motive force and the admittance of the circuit*, and it is further shown (169) that the admittance of a system of circuits in parallel is equal to

$$y = \sqrt{(g_1 + g_2)^2 + (b_1 + b_2)^2}. \quad (177)$$

Now in the present case

$$g_1 = \frac{r_1^2}{r_1^2 + x_1^2} \text{ and } b_1 = \frac{x_1^2}{r_1^2 + x_1^2}$$

but since the circuit O_2A_2 is non-vector,

$$g_2 = \frac{1}{r_2} \text{ and } b_2 = 0.$$

Therefore, as r_2 varies g_2 varies inversely,

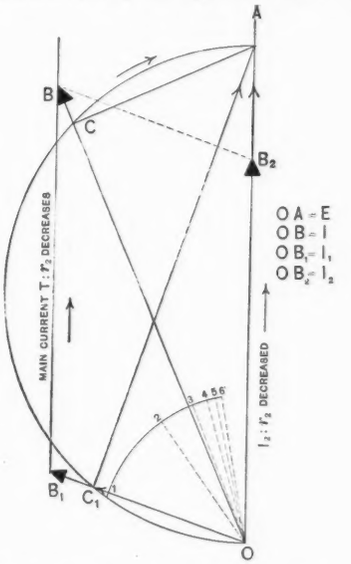


FIG. 69 —ALTERNATING MECHANISMS.

but g_1 and b_1 remain constant.

Example No. 14.

Given: An alternator developing an electro-motive force of 1,200 volts at 60 cycles, which is impressed upon two circuits connected in parallel. The second of these circuits consists of a variable non-inductive resistance having fixed steps of 480, 240, 160, 120 and 96 ohms each. The first circuit has an inductance of .425 henry and a resistance of 442 ohms.

Determine the value of the current in the main line corresponding to each of the fixed steps of the resistance of the second circuit.

When the second circuit is open and the alternator impressed on the first circuit alone by equation (54)

$$I_1 = \frac{1200}{\sqrt{(442)^2 + (163)^2}} = 2.55 \text{ amperes,}$$

since

$$x_1 = L_1 2\pi n = .425 \times 2 \times 3.14 \times 60 = 163 \text{ ohms.}$$

And as the impedance of the first circuit is

$$z_1 = \sqrt{(442)^2 + (163)^2} = 470 \text{ ohms,}$$

the current has a lag of

$$\phi_1 = \sin^{-1}\frac{442}{470} = 70^\circ\ 3'$$

behind the impressed electro-motive force.

Now when the second circuit is closed upon the first step of its resistance a current of

$$I_2 = \frac{1200}{480} = 2.5 \text{ amperes}$$

will be set up in the circuit that is in phase with the electro-motive force.

There is now 2.55 amperes flowing in one circuit and 2.5 amperes flowing in the other, with an angle of phase difference between them of 70° 3′, we can, therefore, most readily determine their resultant, which is the main line current, by applying equation (25), page 479, vol. xxxvii, and

$$I^2 = I_1^2 + 2\ I_1\ I_2 \cos\phi_1 + I_2^2 \quad (25)$$
$$= (2.55)^2 + 2 \times 2.55 \times 2.5 \times \cos 73.05^\circ + (2.5)^2$$
$$I = 4.2 \text{ amperes.}$$

By equation (26) this resultant current will lag behind the impressed electro-motive force by an angle

$$\phi = \tan^{-1}\frac{I_1 \sin\phi_1}{I_2 + I_1\cos\phi_1} = 34^\circ\ 49'$$

If the remaining steps of the resistance of the second circuit are cut in succes-

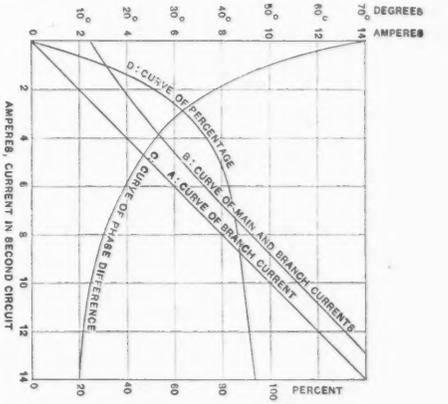


FIG. 70.—ALTERNATING MECHANISMS.

sively, the current in the second circuit will increase by increments of 2.5 amperes, as is shown in Table 6, and there will be a corresponding increase in the main line current. The rate of increase in the main line current is, however, less than the rate of increase of the current in the second circuit, and in fact the value of the current in the second circuit rapidly approaches that of the main current.

This is shown somewhat more fully in Fig. 70, in which the values of Table 6 are plotted against the current in the second circuit. Curve A is the plot of the current in the second circuit against itself; it is, therefore, inclined at an angle of 45°, and is a straight line.

Curve B is the plot of the main line current against the current in the second circuit. This curve continually approaches curve A, although its approach is so gradual in the upper part of the curve that curve B is almost parallel to curve A.

Curve C is the plot of the angle of lag of the main current relatively to corresponding values of the current in the second circuit. It is seen that the main current very rapidly approaches the phase of the impressed electro-motive force when the second circuit is closed and its resistance reduced. But for the smaller values of the resistance the reduction in the angle of lag is very slow and becomes almost inappreciable as the currents grow large. The axis of abscissas is in fact an asymptote of the curve C.

Curve D shows the per cent that the current in the second circuit is of the value of the main current. By it the fact is clearly pointed out that the branch current gradually approaches the main current, and practically equals it for very low values of the resistance in the second circuit. Circuits of the form shown in Fig. 68 are important in alternating current working, as they are representative of the greater portion of distributing circuits. This will be explained in detail later. In the case of the present problem Fig. 68 is a working diagram of the circuits, and Fig. 69 is the vector diagram of the circuits. In Fig. 69 the points numbered 1, 2, 3, 4, 5 and 6 indicate the phase position of the main current values tabulated in Table 6.

TABLE 6.

No.	r_2.	I_2.	I.	ϕ.	$I_2 \div I$. %
1	∞	0	2.5	70° 3′	0
2	480	2.5	4.2	34° 49′	59.5
3	240	5.0	6.3	22° 24′	79.3
4	160	7.5	8.7	16° 1′	86.2
5	120	10.0	11.2	12° 21′	89.3
6	96	12.5	13.6	10° 10′	91.9

Radio-Active Material.

Mr. F. Giesel, in the *Chemical News,* describes how radium rays cause skin wounds. They also cause plant leaves to acquire an Autumnal yellow tint. The author states that salts, glass, paper, etc., are affected, the last-named turning brown and brittle.

Electric Railway Progress in Switzerland.

It will be of interest to those who intend traveling in Europe during the coming Summer to know that an electric street railway line will bring Chamouni—heretofore only to be reached by diligence or the more expensive luxury of a carriage—within easy reach from Geneva at a moderate cost. The line has been built by the Paris, Lyons & Mediterranean Company at great expense from Fayet-St. Gervais, a station two hours by rail from Geneva. During the Summer six trains daily will be run between Geneva and Chamouni, the time of the run being, according to train, three and one-half to four hours. From Paris to Chamouni will take about 14 hours.

The electric line from Fayet-St. Gervais to Chamouni is 20 kilometres (12½ miles) long, having double tracks one metre (39⅓ inches) apart. For 3.6 kilometres (two and one-quarter miles), the cars will ascend on cogs, the steepest slopes having a grade of nine centimetres to the metre (3.54 inches to 39⅓ inches). The system is expected to be in operation by June or July at the latest, and will have a first and second-class service. The fare, second class, from Le Fayet to Chamouni will be 1.95 francs (about 38 cents). The first-class fare has not yet been decided upon.

While many will, of course, continue to make the journey to Chamouni by diligence over the picturesque mountain passes, the simple, comfortable tram connection for even one way of the trip will prove a great convenience; and for the many hundreds of tourists with small means and restricted time, this line will make the mountain scenery of Chamouni an item in the trip that otherwise might have to be omitted.

German Rapid Transit.

Experiments are now being made by the firm of Siemens & Halske, of Berlin, with electric trains having a speed of 125 miles an hour, says United States Consul-General Guenther, of Frankfort-on-Main. The main object of these experiments is to complete the technical improvements for the wheels, necessary on account of the greatly increased rotation.

These experiments, it is now stated, have demonstrated that a speed of at least 125 miles per hour can be attained without difficulty. In using electric motive power, a transformation of the horizontal motion of the piston into one of rotation of the wheels is not necessary; the rotary motion of the motor can at once be transmitted to the axle of the coach or the motor axle can serve at the same time as the coach axle.

A pamphlet issued by the privy councilors of engineering—Messrs. Philippi and Griebel—states that with such electric roads of great speed, surface crossing is out of the question; railroads, streets, passages, and canals must be crossed either by bridges or tunnels. The quick succession of trains (intervals of six minutes) makes it imperative that the tracks must be kept clear at all times while being operated. Neither the public nor employés can be permitted to enter upon them. For this reason the third-rail system must be adopted and switches are to be avoided.

The plan for this rapid electric road between Berlin and Hamburg is as follows: The road will run between a point immediately adjoining the city of Berlin and one adjoining the city of Hamburg. The total length of the line will be about 156 miles. The subways and elevated tracks are already projected for the whole line. The estimated cost, according to Messrs. Philippi and Griebel, is $33,000,000, among which are $4,400,000 for the right of way, $7,200,000 for grading, $10,000,000 for construction, and $5,000,000 for electric power stations, passenger depots and workshops.

Electric Effluvium.

M. S. Leduc describes some further remarkable properties of the silent electric discharge whose physical and chemical effects he has latterly been investigating. He produces it by rapidly charging and discharging a condenser consisting of a metallic sphere on the one hand, and a sheet of aluminum with a central perforation on the other hand, separated by a plate of glass or celluloid. The central portion of the plate is on both its faces the origin of violet and ultra-violet rays, which can be concentrated by a quartz lens. These rays produce an intense fluorescence on a platino-cyanide screen without concentrating the beam. Photographic effects are obtained which surpass in intensity those produced by sunlight. The rays are particularly valuable for Finsen's treatment of anæmic tissues. These are compressed by means of a quartz plate contained in an ebonite frame, which directly adjoins the aluminum sheet forming one armature of the condenser. The diseased tissue is thus exposed to rays which have only to traverse a thin plate of quartz. The apparatus may be worked with an induction coil or an influence machine.

News from Great Britain.

From Our Special Correspondent.

At periodic intervals an outcry is made over here that England is altogether behindhand in some particular industry, and this time it is the electrical industry again. At the beginning of the month a paper was read before the Institution of Electrical Engineers, entitled "The Electrical Power Bills of 1900: Before and After," and apart from giving a digest of the schemes which were passed last season for supplying current wholesale, it consists of a slashing attack upon the obstructive and restrictive methods of the legislature proper and of the smaller local bodies which have been endowed with certain powers of which, if they so think fit, they do not hesitate to avail themselves, generally with unhappy results. The paper has met with a decided approval from such authorities as Professor S. P. Thompson, Mr. Emile Garcke, Mr. J. S. Raworth and many others, and, in fact, during a somewhat lengthy discussion only two speakers raised their voices in favor of municipal electrical trading. In a paper of such a far-reaching character as this, however, it is unsatisfactory to find the author placing reliance upon depreciatory articles anent English electrical progress in a certain class of daily newspaper which no self-respecting electrical engineer (or any one else) would be seen with in his hand.

Be all this as it may, however, I am inclined to think there are other contributory causes to this laxity in the profession. An example of what these are is furnished by the almost violent opposition to the numerous underground electric railway schemes in and about London which are coming before Parliament this session. As soon as particulars of their various routes are published, the responsible daily papers are flooded with letters of protest and appeals to the local authorities, whose districts they pass through, to oppose them on some ground or other. Another instance is the formation of a ratepayers' association of inhabitants on the line of the Central London Railway to force the company to pay compensation for alleged damage to their houses, due to fancied vibration from the trains. All these things retard the industry, inasmuch as they instill prejudice into the non-technical mind, to say nothing of making capitalists dubious as to the stability of electrical enterprise.

With regard to the question of the vibration on the Central London Railway, an expert committee has been formed at the request of the company itself to investigate the trouble, real or otherwise. It consists of the Right Hon. Lord Rayleigh, F. R. S., Sir John Wolfe Barry and Professor J. A. Ewing, F. R. S. The sittings are held at rather long intervals, as between them series of tests are carried out on the line, and it is likely to be some time before their report is published. Mention of Sir John Wolfe Barry reminds

Electric Lighting of the Victoria Embankment, London.

me that he has resigned his position of co-consulting engineer with Sir William Preece for the electrical equipment of the "circle" railway, in London, owing to a difference with the directors as to the most suitable system.

As far back as 1892 the London County Council decided to light the Victoria Embankment by electricity. This roadway runs alongside the River Thames for about a mile or so and is one of the few pleasant spots in the heart of London. In March, 1901, the Council's 1892 decision was put into force. The installation is a small and quite ordinary one, its chief feature, however, being the lamps. The equipment of the power-house consists of four 70-horse-power gas engines with dynamos having an output of 70 amperes at 500 volts. It is interesting to note the use of gas engines, as several of the supply companies in London have recently been fined at the instance of the London County Council for allowing the emission of black smoke from their chimneys, and by this mode of procedure the London County Council has probably avoided the amusing spectacle of summoning themselves for a like offence. A very good view of the lamps on the river side is given in the photograph. The foggy buildings in the background are the House of Commons and Big Ben. There are about 70 lamps on this side and a further 80 for the curbs, for which special standards will be erected. As will probably be imagined, no alteration whatever has been made in the standards or even globes of the old gas lamps, which were exactly as shown in the illustration. The circuits are arranged in series of 10 and are run off a constant potential of 500 volts. The lamps are made by the Gilbert Arc Lamp Company.

No difficulty has been encountered in organizing a second detachment of electrical engineer volunteers for South Africa, and by the time these notes reach you they will probably be on their way.

In addition to its German visit, the Institution of Electrical Engineers is organizing the electrical side of an engineering congress during the Glasgow Exhibition, on September 3, 4, 5 and 6. The Municipal Electrical Association will also hold its annual meeting in Glasgow some time in June.

All interested in railway organization must, for some years, have foreseen that a limit would be reached in the number of manually worked levers in a signal cabin, and a system of electrically worked signals and points, with the object of decreasing the actual manual labor and at the same time increasing the capacity of a cabin, would seem to recommend itself as a step toward ideality. Without claiming to have reached this acme of perfection, however, such a system has been adopted by the London & Northwestern Railway Company, which has now nearly completed a plant of 1,000 levers, one cabin alone containing the unprecedented number of 300 levers. All the original style is retained in the signal box, the levers still being in place, but in miniature, so that a signalman has no new movements to learn. Semaphore signals and ground disk signals are worked by an electromagnet, the arrangement being

very simple. The point movement is by means of an electric motor. The mechanical parts work in a bath of black oil, and the connections with the lever in a signal cabin is a single cable laid down in a rough wood casing. Each point and signal is provided with its own electrical main so that, in case of failure, only one point or one signal is affected. It is obvious that by an electrical means such as this, points and signals can be worked at much greater distances than at present.

In the navy estimates, which have just been presented to Parliament, provision is made for the creation of a new rating, *viz.*, electricians. This is quite a new rank, and, in future, electricians in His Majesty's Navy will be rated as chief petty officers and will act as assistants to torpedo lieutenants. The reason for this step is stated to be the increased electrical work in the naval service.

Another stage in the development of the London United Tramways Company, mentioned in my last letter, is the official inspection by Mr. A. P. Trotter, electrical adviser to the Board of Trade. During the time the inspecting runs were being made, Mr. R. T. Glazebrook, the director of the National Physical Laboratory at Kew, was making vigilant observations of any increased disturbance of his instruments. It is to be hoped that the Board of Trade sanction to the running of the line will not now be long delayed.

It has been decided that the Duke and Duchess of Fife will open the Glasgow Exhibition on May 7. The King, as Prince of Wales, had promised to do this, but his other duties now render it impossible. Lord Blytheswood is the president of the exhibition, and at a recent private function in London it was mentioned that the object of the show was to illustrate the great advance which has been made in science and art throughout the world during the nineteenth century. The last exhibition of the kind held in Glasgow was in 1888.

It was further stated that the Russian Government will spend some £30,000 on a pavilion in which the Russian exhibits will be situated, and that among the Oriental countries represented are Japan, the Ottoman Empire, Morocco and Persia. I may further add that the municipality of Glasgow has provided the site and guaranteed £500,000. It is noteworthy that stallholders have been offered a municipal telephone service at £3 during the time the exhibition is on. The ordinary service is five guineas per annum.

The following brief general particulars are also of interest: The buildings cover some 54,000 square yards of ground and really consist of two main portions, the one devoted to machinery taking 20,400 square yards. Communication between the two is maintained by means of what will be designated the Grand avenue, which is some 1,000 feet long, 75 feet wide and 40 feet high. The boiler and dynamo house attract our attention. There are four Lancashire and five water-tube boilers, the latter being worked in connection with the dynamos. Sturtevant forced draught has been adopted. No less than 14 firms are supplying engines and dynamos, and the plant for providing the exhibition with light and power comprises 12 steam-driven sets, five of which will be worked at a pressure of from 500 to 550 volts and seven at from 250 to 275 volts. Various types of 10-ampere Brockie-Pell arcs will light the buildings, 10 lamps being run in series on the 500-volt mains. Quite ingenious is the suggestion which has been carried out and by which each of the substation switchboards has been fitted with change-over switches, enabling the supply to be obtained either from the exhibition's private installation or from the Glasgow corporation's electric mains.

The Board of Trade electric lighting regulations, under which all such concerns work—both in and out of London—and which were published in 1896, contain a proviso that the pressure declared at a consumer's terminals when supply is first given, shall not be altered without that consumer's consent. Since 1896 a steady improvement in the 200-volt lamp in conjunction with an imminent overloading of many of the supply companies' 100-volt mains, has induced them to come to terms with their customers for a supply at 200 volts. In some instances, however, a sharp-witted customer has stuck out for pretty substantial compensation, and the result has been an appeal to the Board of Trade for the abolition of the above proviso and so enable the undertakers to dispense with the consumer's consent. An inquiry was instituted which lasted for two days a week during March and it is pretty safe to forecast that a compromise will be effected.

A startling fact, however, brought to light by this inquiry is the great diversity of opinion among the tip-top of the profession, as to whether a 200-volt lamp as at present on the market is a commercial commodity. As an instance of this, Professor A. B. W. Kennedy says it is and Professor W. E. Ayrton says it is not, and the curious part of the business is that both have made tests and both are prepared to back up their statements. With such a state of affairs existing, the poor non-technical consumer will have to put up with what his own supply company advises him, unless he can afford a consulting engineer to carry out tests at his (the consumer's) expense to discover what is the best that we have got. There were numerous witnesses on both sides, and while everybody, no doubt, believes he is right, personally I have been working with 200-volt lamps for some 18 months and have never had cause to complain.

A public motor car service—not in anyway an omnibus service—has been inaugurated in the south of London and bids fair to become a success. At present only six cars are built, of which two will be held in reserve in case of breakdown. The cars only carry 10 passengers—eight inside and two by the driver. The engines are of the Daimler type, with tube ignition. This goes far to demonstrate how much London is in want of a really efficient electric car service. Since the death of the cab company, no effort has apparently been made in this direction, with the exception of one solitary steam-driven omnibus which labors—or used to—across London for about a mile or so, and was lucky to do the journey without a breakdown.

A. W.

London, March 30.

The Nisqually Falls Power Plant.

A company has recently been formed in Tacoma, Wash., for the purpose of erecting a large power plant to utilize the waters of the Nisqually River, and a dam is now being erected at the narrowest part of the Nisqually Cañon, which will raise the water so that a 200-foot head may be obtained. At the point where the dam is being erected the cañon is from 60 to 100 feet in width and has a mean depth of 225 feet, the sides and bottom being of granite. The power-house will be situated below the dam on a bench of rock and the present plans call for machinery which will develop 15,000 horse-power. The engineering plans of the company are not yet completed, but it is estimated that 30,000 horse-power can be obtained from the river at this point (24 miles distant from Tacoma) and the power plant will be increased and developed as seems necessary. From the falls, transmission lines will be run to Tacoma and Olympia and it is stated that there is sufficient demand in the former city to take practically all the power that can be supplied by the company. At the present moment the cost of the plant is figured at about $400,000.

THE CONSTRUCTION OF SMALL TELEPHONE EXCHANGES—VII.

BY A. E. DOBBS.

PLAN OF DISTRIBUTION.

One plan of cable distribution that has found favor with a great many construction men, where there are several cables, is shown in Fig. 27. We will suppose that in this case an allowance is made of 25 subscribers to the block and that the cable shown begins the distribution nearest the exchange. This would naturally make this cable No. 1. Supposing that the cable contains 100 pairs, we end it at the first distributing point and connect in a 25-pair terminal, and also by means of the Y-splice described in the previous chapter, connect in a 75-pair cable for further distribution.

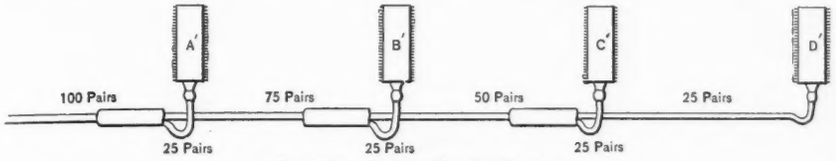


FIG. 27.—CABLE DISTRIBUTION.

Continuing to the next distributing point, we take out 25 pairs more and continue on with a 50-pair cable and so on till the last stretch is reached with only a 25-pair cable. Beginning at the terminal nearest the exchange the first cable, as said before, being called No. 1—the first box is called A, the second box B, the third C, and so on. At the exchange distributing rack the A box would take the numbers from the first to the 25th pair, the B box from the 26th to the 50th pair, the C box from the 51st to the 75th, and the last one, the rest of the pairs, 76 to 100. The distribution of wires in this case should always be in the direction away from the exchange and the wires on the cross-arm pins should always be numbered from one to fifty, the same as the cable terminal, so that when necessary the wires can be found when once the cable number is known. This is on the supposition that ten-pin arms are used and numbered in the usual manner in multiples of 10. To count an arm, stand facing outward from the exchange and count the top arm from one to ten, the second from 11 to 20, the third from 21 to 30, etc.

Coming back to our subject, however, all the other cables should be numbered systematically and the terminals also take their terminal numbers, as A, B, C, etc. In this way connections and troubles can be quickly traced and located. A record of all cable connections should be carefully kept in the manager's office.

There are other systems of distribution known as "loop" and "multiple" distribution, which provide for picking up cable numbers at more than one terminal. Suppose, for example, that all the numbers brought into cable box A, are not needed at that point while they may be needed at box B. If we have cable conductors that can be used at either place, it gives a greater flexibility to the system, although somewhat more expensive as to first cost owing to the larger sizes of terminals and cable required. In one case, for example, there would be need for a 50-pair terminal at box A, instead of a 25-pair terminal, as in Fig. 27, and in the other there would be a 100-pair cable between boxes A and B, instead of one having only 75 pairs. As no two towns are laid out in the same manner and local conditions differ in each, so no two methods of cable distribution can be made in the same way.

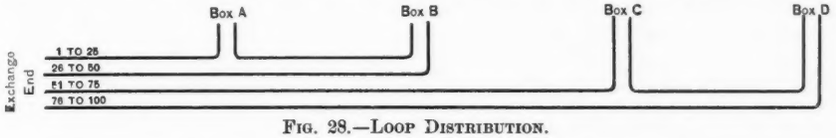


FIG. 28.—LOOP DISTRIBUTION.

LOOP DISTRIBUTION.

In the loop system we would begin at box A, and instead of taking a 25-pair short cable into box A, we would splice in one of 50 pairs, cutting the cable at this point; 25 pairs we will bring into the left-hand side of this 50-pair terminal, which will be connected to the end next the exchange, making the splice as already shown.

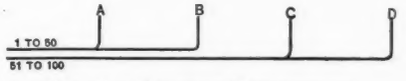


FIG. 29.—MULTIPLE DISTRIBUTION.

This side will be numbered from 1 to 25, as already explained, while the other side is connected to the outgoing end, and carried along to box B, where these pairs are also brought into a 50-pair terminal, and the 25 pairs continued forward from box A, carried up to the left-hand side as before. The cable is also cut here and an additional 25 pairs brought from 26 to 50 up to the right-hand side of the B terminal, these being numbered at the exchange. It will, perhaps, have been noticed by this time that the first 25 pairs are now open between terminals A and B. Should, however, any of these be needed at box B, it becomes a very simple matter to connect them straight through at the A box, either inside or outside of the head, while on the other hand, if any of the second 25 pairs should be needed at box A instead of box B, they could be distributed back instead of ahead by cross-connecting from the second 25 pairs to any vacant pairs coming in on the loop end from box A. At box B, we now reduce our cable to one of 50 pairs and continue the distribution as before for boxes C and D. In this plan the line wires would naturally be connected to the side of the terminal going directly to the exchange, which would be the left side at box A and the right at box B, until that side was exhausted.

This method of distribution can best be illustrated by the diagram shown in Fig. 28, in which, for convenience, the cable is divided into four groups of 25 pairs each. Of course the cables do not necessarily have to be divided into groups of 25, as any other number can be chosen if desired. When distributing in residence districts groups of 10 pairs might be more feasible.

MULTIPLE DISTRIBUTION.

This system is shown diagrammatically in Fig. 29 and is not used now as much as formerly, owing perhaps to the fact that if a cross or ground should occur in any of the conductors between the boxes the only way to locate or dispose of it lies in opening the cable at the splice made at A. This is always objectionable. In the loop system a fault might occur between the A and B boxes, but by simply leaving it open at the A box the faulty conductor can be used as far as A and disconnected at B, by simply opening the terminal

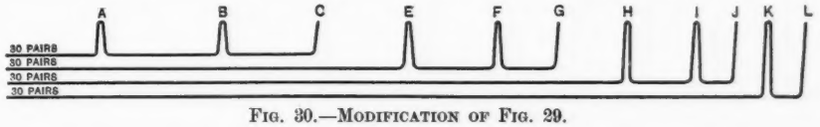


FIG. 30.—MODIFICATION OF FIG. 29.

head and cutting it loose from its terminal post. There is still another method, sometimes used in residence districts, where shade trees and scattered subscribers make the use of more than two arms on a pole objectionable, which is illustrated in Fig. 30.

As will be seen, this is a modification borrowed from the conduit system of electric light wiring and possesses most of the advantages of the loop system. In this case, for greater convenience, we use a cable of 120 pairs split up into divisions of 30 pairs each, and distribute from three boxes instead of two, bringing both ends of each group into the terminal of 30 pairs and soldering both ends of the loop into one tip. In this way it is possible to pick up any one of these pairs at any one of three terminals and, at the same time, if any of the conductors should be in trouble between the boxes it becomes an easy matter to open the terminals and test both ways and cut out the faulty end if found anywhere beyond the A box. This system is now being used to a greater or less extent by the best construction engineers in both the Bell and independent exchanges, and there is more and more a tendency shown to rely on cable distribution as much as possible, and to use no more aerial wires than are really necessary, and then only short lengths of insulated duplex or twin-conductor wire. In this way a metallic circuit system is easily installed.

CABLE TERMINALS.

There have been many different forms of cable terminals placed on the market in the past few years, but the iron box is the only one that seems to have found permanent favor with customers generally, for the reason that it is comparatively cheap, mechanically strong, long lived, easy to handle, can be readily opened up or disconnected, and changed from one locality to another if necessary. They should be so constructed that they can readily be opened for inspection or repairs without disconnecting any lines or disturbing any fuse connections. Fig. 31 shows in a general way the common form of these terminals which, in the present case, does not contain either fuses or lightning arresters. The lead cable is shoved into the nipple from below and connected to it by means of a plumber's wiped joint. Sometimes a sleeve is also connected to the nipple for greater convenience in case it becomes necessary to take the cable out of the terminal at some future time.

There is also another method, sometimes used, shown in Fig. 32, which consists in simply shoving the cable through the nipple up to about an inch above the bottom of the terminal, then making a tight joint at the bottom of the nipple with friction tape and filling the nipple full of heated asphaltum or rosin which sets hard when cold and holds the cable in place. In order to make sure that the cable will not slip down, the upper end of the lead sheath may also be wrapped with tape so that it is just a little larger than the inside of the nipple. Fill with the compound up nearly to the top of the lead sheath on the inside. Then pour hot ozite or paraffin into the cable sheath until bubbles cease to rise, when the connections can be made to the tips

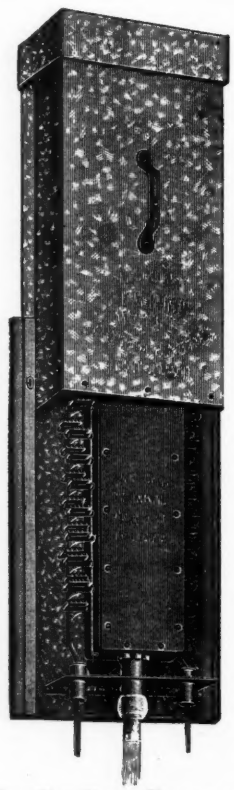


FIG. 31.—CABLE TERMINAL.

and the cover put on. There is generally a rubber gasket that goes underneath the iron cover in order to make an air-tight joint.

It is not necessary to fill the whole head with paraffin or ozite, but the ends of the wires, if having paper or cotton insulation, should be boiled out in paraffin before they are "fanned out," in order to prevent absorption of moisture from the air. Some cable men prefer to test these wires out and lash them into a spider form before connecting them into the terminal tips, but this is not really necessary.

When the wires have been fanned out to their tips in the head, they should then be *well* soldered in order to insure a reliable contact at all times, especially if a central-energy system is to be used, for if not thoroughly soldered—that is, a perfect union of the two metals—there will surely be open circuits sooner or later. Rosin or soldering salts would be best for this work on account of their non-corrosive qualities, but if not thoroughly heated they will make a pretty good insulation between the wire and its tip, and therefore it is probable that what is known as the "underwriters solution" would better be used. This can be obtained at any drug store, and is made as follows:

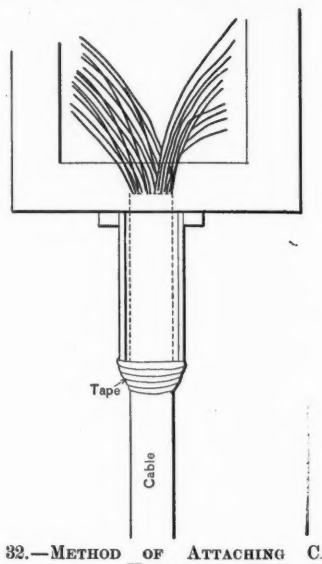


FIG. 32.—METHOD OF ATTACHING CABLE HEAD.

Saturated solution of zinc (muriatic acid in which zinc has been dissolved)	4 oz.
Alcohol	4 oz.
Glycerine	1 oz.

Care should be taken not to spill any liquid flux in the interior of the terminal or on any of the wires, as it makes a very good conductor and cables have been ruined before now by a little carelessness in the use of acid.

Street Railway in Mannheim, Germany.

A new electric street railway system has been installed in Mannheim, Germany, to take the place of the street horse-car line in use up to the present time. The new equipment is said to be modern in all respects, the track being heavy and laid on a solid foundation of concrete. The electric equipment was furnished by Siemens & Halske, of Berlin, and the cars furnished by the Hamburg Car Company, the whole system belonging to the city and operated by a street-car bureau appointed by the local government. The power for operating the cars is furnished by the city lighting and power plant and considerable extensions of the system are contemplated during the year. The lines have been in use for about five weeks and the management of the road claims to be well satisfied with the travel, the fares being based on a minimum of 10 pfennigs (2.38 cents) and 15 pfennigs (3.57 cents). Over the longer courses, by the purchase of 50 tickets, these rates are reduced to a little less than two and three cents, respectively.

SYSTEMS OF ELECTRIC TRANSMISSION AND DISTRIBUTION—II.

BY CHARLES P. STEINMETZ.

As regard to speed, the induction motor is essentially synchronous also; that is, its speed is determined by synchronism with the alternating-current supply. The induction motor, however, does not keep perfect step with the generator, but slips slightly behind, being almost perfectly synchronous at no load and decreasing in speed with increasing load from a fraction of one per cent to a few per cent. Having no commutator, collector rings, brushes, etc., the induction motor is the most reliable of all motors, but has, compared with the synchronous motor, the disadvantage of lower efficiency and of producing wattless lagging currents in the system. In its characteristic features the induction motor essentially corresponds to the continuous-current shunt motor, and like the latter can be slowed down only by insertion of resistance in the armature, being then less efficient in starting and at low speeds, by using the same power which it would use at full speed with the same torque. While, however, the speed of the continuous current shunt motor can be varied efficiently, within a limited range, by varying the field excitation, this is not feasible in the induction motor. To the variation of speed of the continuous-current shunt motor by varying the voltage impressed upon the armature, as by connecting the armatures of two motors in series, corresponds in the induction motor the variation of speed by varying the impressed frequency, which, by the use of two motors, can be carried out by concatenation or tandem connection; that is, with the secondary of the first motor feeding the primary of the second motor. A change of speed by changing the number of poles is much more feasible in the induction motor than in the continuous-current shunt motor, since the induction motor has a distributed winding without definite polar projections, and this method thus is used to quite some extent for two-speed induction motors.

No alternating-current motor, however, exists which has the characteristics of the continuous-current series motor, and for classes of work as railroading, where these features are required, the alternating current is decidedly inferior. Thus for railway work continuous current is exclusively used in this country, and almost exclusively abroad.

IV.

Some of the chief problems of electrical engineering are:

(A) Long-distance transmission and distribution.

(B) Distribution of electric current for lighting and power.

(C) Distribution of electric current for railroading.

(D) Electrochemical work.

a. In long-distance transmission and distribution, exclusively alternating currents are used, since the voltages required are far beyond those available in continuous-current apparatus. The three-phase system is almost always preferred as the most economical. That is, with the same amount of power transmitted at the same loss and with the same maximum difference of potential between the conductors, the three-phase system requires only three-quarters the conductor material of the single-phase or quarter-phase system. The loss of power in a conductor is proportional to the square of the current. With the same power transmitted, the current is inverse proportional to the voltage, and thus the loss of power inverse proportional to the square of the voltage, or inversely, with the same loss of power and the same power transmitted over the same distance, the amount of conductor material is inverse proportional to the square of the voltage used. To compare different transmission systems, they have to be resolved into components of the same character. Thus a two-wire single-phase system with 10,000 volts between the conductors can be considered as two 5,000-volt single-phase systems without return. That is, instead of considering the current as outgoing in one conductor and coming back over the other conductor, we can consider both conductors as carrying outflowing currents, but of opposite directions, and assume both currents as returned over a neutral midway in potential between the two conductors. Since, however, the two currents are equal and opposite the resultant thus zero, the return current in the neutral is zero, and the return conductor can thus be omitted. In the same way a four-wire, quarter-phase system of 10,000 volts per phase can be treated as four 5,000-volt, single-phase systems without return, and requires the same amount of conductor material as the single-phase system, since the transmission voltage is the same. A three-phase system with 10,000 volts between conductors can be considered as three single-phase systems without return, of a voltage equal to the voltage between the centre or neutral and the corner of an equilateral triangle of 10,000 volts as side; that is, of a voltage $\frac{10,000}{\sqrt{3}}$. Hence the effective transmission voltage of the three-phase system with the same maximum voltage between the conductors is $\frac{2}{\sqrt{3}}$ times that of the single-phase or quarter-phase system, and the conductor material required thus $\left(\frac{\sqrt{3}}{2}\right)^2 = \frac{3}{4}$ as great.

The limiting distance of electric-power transmission at present is only an economical one, and is reached when the cost of electric power, including interest on the investment in the transmission line and the development of the water power, exceeds the cost at which power can be produced at the receiving end. Thus the distance is far greater in the West, where coal, and thus steam power, is expensive, and water power of high head, and a climate favorable to the use of very high transmission voltages makes the cost of electric transmission lower. Transmission voltages up to 40,000 are then in successful commercial operation, and voltages up to 75,000 under serious discussion.

For long-distance distribution, as when supplying a large city or a district with electric power by a number of substations from one central generating station with steam engine or turbine-driven generators, lower voltages, 6,600 or 11,000, are generally employed, partly because the distances are usually less than in long-distance transmissions, and by limiting the transmission voltages to these values it can be produced directly in generators and utilized directly in synchronous motors. Especially, however, this lower voltage is used because generally a large part, or even all, of the power has to be transmitted by underground cables, and cables are not as suitable for very high voltages as overhead lines.

b. For lighting and power distribution, alternating as well as continuous currents are used. If the customers are far apart from each other and from the station, alternating current must be used and individual customers supplied by separate small transformers from high potential (1,000, 2,000 or 3,000 volts) primary feeders. With the increase of demand, adjacent customers are preferably connected to the same transformer, and ultimately, in this manner, a number of customers are supplied from the same secondary main fed by a large transformer. The voltage regulation, which, as a rule, was fair with individual transformers, is liable to be impaired by the installation of long secondary mains, due to induc-

tive drop in the mains, especially if induction motors or arc lamps are connected thereto, but it is improved by connecting the secondary mains with each other, so establishing a secondary network fed by a number of large transformers feeding into the secondary mains at proper places. By controlling the voltage in the primary feeders supplying these transformers, by means of potential regulators, etc., in such a system, just as good a voltage regulation can be secured with proper care in installation and operation as with the continuous-current system of feeders and mains.

As soon, however, as the load becomes so concentrated that several hundred kilowatts can be reached from the same distribution centre with low potential, it becomes preferable to change to continuous-current distribution, to gain the increased simplicity and easier control of large low-tension currents afforded by the continuous-current system.

Thus we find in the centres of large cities, where the load is concentrated, and where elevator motors also are of importance, continuous-current, three-wire distribution systems fed by one or a number of generating stations or converter substations, and surrounding the continuous-current district a zone of alternating-current distribution, reaching on its outer sides further into the suburbs and outlying districts, and at the same time losing ground at the inner side to the continuous-current system by districts being changed to continuous current as soon as the load becomes sufficiently concentrated. The alternating-current distribution thus supplements the continuous-current centre, doing pioneer work for the latter, and supplying power to places which are out of reach of continuous-current supply.

The historical development has frequently been the opposite; that is, a continuous-current central distribution has adopted alternating current to reach further outstanding territory, and still more frequently the continuous-current system in the centre of the city and the alternating system in the suburbs have been installed independently and even in competition with each other, and afterward combined, each taking that part of the load for which it is best suited.

c. For electric railroading, surface railways as well as elevated roads, continuous current is used exclusively, with the only exception of a few European roads. The reason is the character of railway load, which requires a motor of the features of the continuous-current series motor, and no such motor exists for alternating current. Furthermore, the three-phase induction motor, by using the ground as conductor, would still require two trolley wires instead of one with the continuous-current motor, and thus cause an objectionable complication where crossings and switches are frequent.

In the interior of cities the railway motor continuously starts, accelerates and, before it has reached full speed, or soon after, is shut off again for the next stop. Still more this is the case on elevated railroad service. In starting and at low speeds, however, the alternating induction motor is inferior in efficiency to the continuous-current series motor, even if superior at full speed.

On suburban and interurban lines constant-speed running is more frequent, starting less, and here the alternating induction motor could be used to advantage, the more as switches and crossings are less frequent and the double trolley therefore less objectionable. However, even in such lines no urgent need exists for the use of the induction motor, since, by the converter, continuous current can be supplied to practically any distance (different it is in Europe, where the converter is still almost unknown). The alternating induction motor car has the disadvantage that it can not be run into and over the city railway lines connecting with the suburban line, and has the further disadvantage of being a special apparatus, while the continuous-current railway system has been standardized and developed in its minutest details since years, is familiar to everybody, and, as standard apparatus, necessarily cheaper. In consequence hereof, the induction railway motor can expect to find an introduction only in special service, as, for instance, for mountain railways, where the feature of the induction motor, on the down grade, by exceeding synchronous speed, to become generator and return power into the line and so exert a braking action, would give the alternating-railway system an advantage in efficiency and reliability. For high-speed, trunk-line service, as for instance, an electric railway connecting New York and Philadelphia, and running 100 miles per hour average speed, the induction motor would undoubtedly be chosen. Thus far, however, electric railroading is still specifically continuous-current work, and will probably stay so for some time, and wherever alternating current is used in generation and transmission, converters are employed to feed the continuous-current railway network.

d. Electrochemical work, while now of enormous importance, is so special in its character that it can only be mentioned in such a general discussion.

Electrochemical work consists of two classes—electrolytic work, where the chemical action of the electric current is utilized, as aluminum reduction, etc., and therefore continuous current is essential, and electrometallurgical work, where the heat of the electric current is used, and alternating as well as continuous current can be employed. In the latter case, however, almost exclusively alternating current is used, since continuous current can not sufficiently be controlled for this class of work. The electric furnace is used in chemical reactions requiring a higher temperature than can be produced by combustion. The problem in this case is to supply approximately constant power to the furnace (so as to maintain approximately constant temperature). The furnace represents a rapidly and violently fluctuating resistance. Alternating generators and transformers can be built to control inherently for approximately constant power over a wide range of resistance, and even when operating the furnace from constant-potential mains, the enormous self-induction of the very large low-voltage currents used for the furnace tends more or less to constant-power regulation, while this is not the case with constant-current supply.

Besides this, where both forms of current can be used equally well, alternating current is always preferred, as simpler to generate, transmit and control.

The Society of Model Engineers and Electricians.

A society of electricians and model engineers has recently been organized in New York city, and has for its object the bringing together of persons interested in the construction of model electrical apparatus. The gentlemen who have organized the society intend to have permanent quarters somewhere in New York, equipped with machinery and power which will be available to the members at all times, together with such tools and apparatus as may be necessary for practical construction, experiments and demonstration in the applied sciences and mechanics. Later on, when more money and a larger number of members have been obtained, lecture and meeting rooms will be provided and an up-to-date reference library will be opened to the members. As the membership will be limited, it is desired by the secretary, Mr. C. Kehrer, whose address is 1200 Madison avenue, New York city, that those who desire to identify themselves with the movement will communicate with him. In connection with the society a workshop and laboratory will be opened and a course in practical machine construction given, embracing all the details of actual machine work.

BENJAMIN FRANKLIN'S CONTRIBUTIONS TO ELECTRICAL SCIENCE—III.

BY EDWIN F. NORTHRUP.

DISCOVERY OF THE NATURE OF LIGHTNING.

In the experiments that Franklin had made his mind had grown familiar with the peculiar manifestations of the electric discharge. Nature exhibited like phenomena on a far grander scale in thunderstorms. The points of similarity in the discharge of his gallon jars and the vivid flash and noise in the sky did not escape his observant mind. He preserved memoranda of his experiments in which these similarities were noted, and he says modestly: "The thought was not so much an out-of-the-way one but that it might have occurred to an electrician." In these memoranda he noted down, on March 7, 1748, "Electric fluid agrees with lightning in these particulars:

"1. Giving light. 2. Color of the light. 3. Crooked direction. 4. Swift motion. 5. Being conducted by metals. 6. Crack or noise in exploding. 7. Subsisting in water or ice. 8. Rending bodies it passes through. 9. Destroying animals. 10. Melting metals. 11. Firing inflammable substances. 12. Sulphurous smell.

"The electrical fluid is attracted by points. We do not know whether this property is lightning. But since they agree in all the particulars wherein we can already compare them, is it not probable they agree likewise in this? Let the experiment be made."

And it was made. The method he had originally proposed was to erect in some high place a sentry box from which was to rise a jointed rod insulated at its base by a cake of resin. Electrified clouds passing over this would, he conceived, be made evident by electrifying the rod which would give sparks to conductors held near it. This plan was not at the time put into effect, but in the Summer of 1752 he conceived the idea that access to the clouds could be had more readily by a common kite. Aware of the ridicule that would attach to failure he made his famous kite experiment secretly, taking only his son to assist him. The actual manner of this experiment was as follows: A kite was constructed of two cross-sticks and a large thin silk handkerchief in place of paper to resist the rain. A tail was attached, and to the top of the kite a pointed wire. The string was of hemp which somewhat conducts electricity when dry and perfectly when wet. To the end of the hemp string, after the kite was in the air, a key and a silk cord were tied. The kite string and key were insulated when held by the silk cord, which was covered by a shed to keep it dry.

At the approach of the cloud the looked-for result came. The fine filaments of the hemp string suddenly stood erect. Presenting his knuckle to the key a smart shock was felt. Leyden jars were then charged from the key and the identity of lightning and electricity established.

The results obtained by this experiment were accepted and verified by many investigators in Europe. Franklin, ever of a practical turn of mind, and desirous of being of immediate use to mankind, soon after developed the lightning rod. The general form which he gave to it, and the rules which he laid down for the manner of erecting it, have remained practically unaltered to this day.

We can not take space to describe the numerous and long-continued experiments which followed this discovery on the state of electrification of the clouds, nor can we enter into his theoretical discussions regarding the origin of atmospheric electricity. The matters have now only historical interest. Most of his conjectures on this subject possess now little scientific value. It is, indeed, for the most part as true of Franklin, as it is in general with scientific investigators, that the permanent value of his work rests chiefly on the facts which he ascertained, and not on his conjectures and hypotheses.

MISCELLANEOUS EXPERIMENTS.

In addition to his more serious experiments made to investigate the laws of electricity, Franklin invented, to entertain his friends, many ingenious electrical demonstrations. We will merely mention a few of these.

He constructed what he termed his magical picture. This was a portrait of the king of England, wearing his crown. The crown was constructed of metal and joined electrically to a sheet of tinfoil on the back of the picture. This being charged, his friends were asked to try and remove the crown, in doing which they received a severe shock for their treasonable attempt.

A season of experiments is ended by holding an "electrical feast," in which a turkey is killed by the "electric shock," and roasted before a fire kindled by the "electrified bottle," and toasts are drunk from "electrified" bumpers (tumblers electrified like a jar so as to give a shock when presented to the lips), under the discharge of guns from the "electrical battery."

In addition to these and many other experiments made for amusement and those bearing on his general theories, almost every fact of electricity known in his day and many of his own discovery were tested. He shows how an electrical wheel may be constructed which will revolve under the influence of electrical attraction and repulsion. The effects of electricity in rending and igniting substances are studied. The conductivity of many materials was investigated and lists made of the two classes of conductors and non-conductors.

He showed that glass when highly heated will conduct.

Improvements were invented and tried in the making of Leyden jars and other electrical contrivances. But we must pass over all these historically interesting details and describe the one-fluid theory of Franklin, which for 25 years was universally accepted, and still exerts a widespread influence on electrical language and thought.

Blizzard in the West.

Southwestern Pennsylvania was the centre of a heavy snow-storm on April 3, which damaged property to the extent of about $300,000, the telephone and telegraph companies being the heaviest losers. The snow began falling in the morning, and clung tenaciously to everything it touched, being heavy and wet. Within a few hours after it began to fall the street car lines in Pittsburgh and neighboring cities had to suspend operations, and shortly after this the trunk lines of several telephone companies gave way under the weight of the snow, and in falling carried with them trolley and electric light wires. In Pittsburgh itself, in the streets traversed by the Consolidated Traction Company, where the fallen wires failed to break, the trolley tracks were completely blocked by the tangle for four hours and a half. Suburban towns in the vicinity of Pittsburgh reported business at a standstill for a portion of the day, and in Allegheny a land-slide occurred which covered the car tracks to a depth of five feet. All railroad trains from the East were hours late, having encountered snow from 12 to 15 inches deep in the mountains, which was so wet and clinging that the snow plows could not clear the tracks. Very similar conditions prevailed in Bath, N. Y., and the snowfall amounted to several inches in that city.

There were 1,666 new companies incorporated in the state of Ohio during 1900, with a total capital stock of $77,593,199. Of these companies 14 were electric light and power companies, 417 were manufacturing, 35 were street and electric railway, and 69 were telephone and telegraph companies.

ELECTRIC VEHICLES AND STORAGE BATTERIES.

BY THOMAS J. FAY.

In view of the fact that electric vehicles are, as yet, more or less unsatisfactory to users in general, and the further fact that most of the cause for dissatisfaction is charged to the battery, the question arises as to why known troubles are left untouched, and why builders of vehicles lament the non-appearance of a battery up to their ideal. As nearly as the writer can discern they want a battery about as follows:

(*a.*) Light enough so that cheap cast-iron and clumsy ironwork, in general, can go into the vehicle, and not bring the total weight above the allowable maximum for rubber tires.

(*b.*) With capacity enough to do 50 miles (some want a hundred) in a vehicle not provided with self-oiling bearings, fitted with motors too small for the work, and thus inefficient, with gearing that rattles and grinds enough to be considered a nuisance a block away, with brake bands that are never free, and with wiring so poorly installed as soon to produce a general and by no means small leakage of current.

(*c.*) With a battery space just large enough to hold the smallest battery that skill and ingenuity can make, and be worth calling a battery.

(*d.*) With no provision for keeping the battery warm in Winter weather.

(*e.*) With no adequate ventilation of the battery compartment in Summer weather.

(*f.*) With no means for suitably charging the battery.

(*g.*) With antiquated and ruinous ideas as to the manner in which the battery should be charged.

(*h.*) With drivers that wear themselves out getting up speed, and putting on the brake, alternately, or, perhaps, putting on the brake and trying to get up speed.

(*i.*) With a lot of other advantages (?) too numerous to mention.

It would seem as if the good practices of other electrical industries might find a way into the field of electric vehicles.

The fact is, that the electric vehicle must be refined, the parts must be strong, but light, the centre of gravity low, the insulation of the wiring permanently high, the motor large enough to do the work at a good efficiency, the bearings self-oiling and aligning, and the battery compartment large enough to accommodate a suitable battery and means for keeping the battery warm in Winter and cool in Summer.

It is thought by many that an underslung battery, that is to say, a battery hung under the vehicle, is the best design, as the weight will be low, the space to hold it adequate, the ill effect of acid fumes on the body wiring and metal parts put to naught, and means for ventilation in the Summer easy of attainment, while in cold weather the case for the battery can be closed, and if built with double walls, "*à la* icebox," will maintain a moderate temperature within.

The battery requirements are simple, nevertheless urgent, and to disregard them, leads but to disaster. In the first place, the battery jars should be separated from each other by at least one-sixteenth of an inch to prevent inter-cell leakage. The cells themselves should be large enough to permit of a three-eighth-inch rubber tube being inserted down one side, in order that the electrolyte can be drawn off and equalized, or replaced if impure, and the height such that a suitable space for sediment can be reserved in the bottom of the jars as well as a liberal space for clearance between the tops of plates and cross-bars, to say nothing about keeping the plates well submerged in electrolyte.

Vehicle makers were at first led to believe they were doing all for the battery that the battery required; that was because, in the early days of vehicle construction, there was but one battery to consider; one whose success in stationary work led its makers to infer that it would be equally successful in vehicle work, even though no especial provision be made such as might be favorable to the battery. There is now no question but that vehicle makers will have to revise their plans; then, and then only, will electric vehicles win back the patrons, who now prefer "a streak of steam" or the odor of gasoline, rather than be left regarding a cornfield six miles from no place.

The writer, who has made some hundreds of tests of electric vehicles, has never been able to verify the statement that vehicles will run on an expenditure of 100 watts per ton-mile. Public cabs, as now built, will take about 150 watts per ton-mile, under average conditions in the streets of New York, provided the vehicles are in the best of condition, but the day after a rain-storm, with mud, tests of this sort are but "chaff in the wind;" the mud gets into the bearings, the wheels slip, and there you are with an overloaded battery—that is, provided it is not so small as to be overloaded under normal conditions, in which event the overload on a muddy day resolves itself into gross abuse, pure and simple.

There is still another cause for troubles in electric vehicles, and that is the absence of a reliable odometer on the vehicle. When a vehicle travels, say, 12 miles an hour, it is easy enough to fall short on a mileage guess, whereas a reliable odometer would put one into possession of the facts in the case, and, furthermore, a sturdy volt-amperemeter would answer a good purpose.

It is to be supposed all these innovations will come in time and, when they do come, the electric vehicle will be the supreme knight of the road.

Electrical Water-Power Development in India.

In a very interesting letter from its correspondent in Simla, India, the New York *Times* prints the following concerning the water-power situation in that neighborhood:

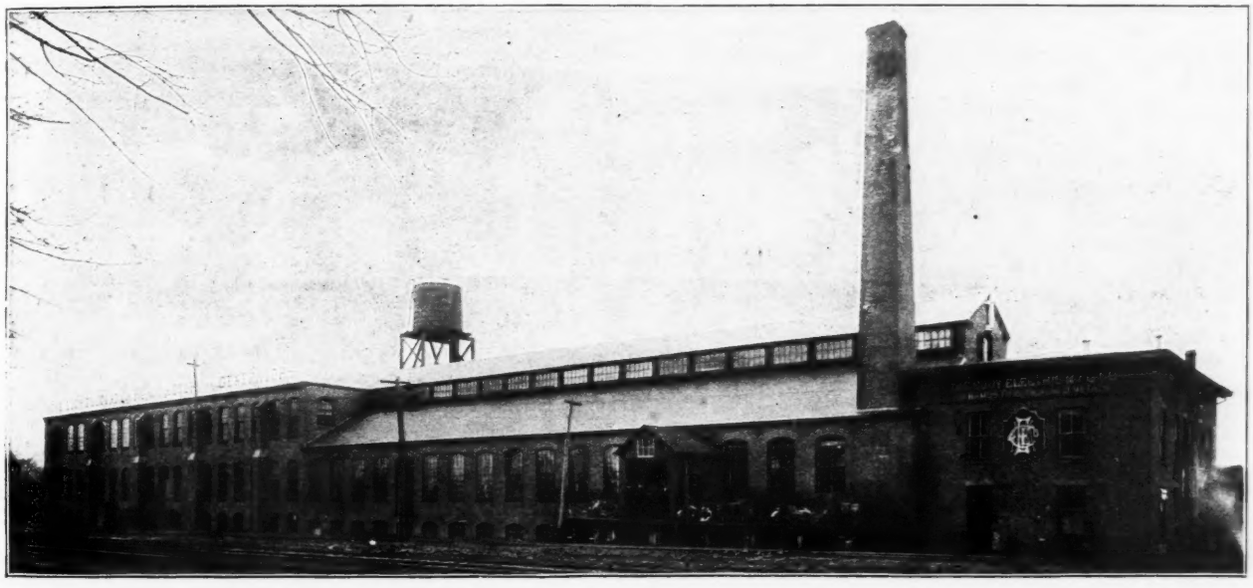
In matters electrical, which have hitherto been shamefully neglected in this country, we are now beginning to make a move. We have in India millions of horse-power running to waste in the big rivers which, fed by the vast snow fields of the Himalaya range, run from the mountains to the sea. Unfortunately it is only possible to utilize the power of these waters at a convenient distance from the foot of the hills, and it so happens that there are no towns of any importance near the hills. All are far out in the plains. In time, no doubt, we shall adopt the American principle of bringing the towns to the power, as in the case of Niagara and other places. But there are other rivers in India besides those flowing from the Himalaya which can be utilized for power purposes. There is now in course of execution a scheme for the utilization of the power running to waste in the River Cauvery, which would be deemed of merit in America itself. The Cauvery rises in the northern portion of the native territory of Mysore, and flows, partly through Mysore and partly through British territory, to the Bay of Bengal. The falls on the river which it is now proposed to utilize are 320 feet in height, but for a mile above the actual falls the river runs in a series of rapids, dropping a hundred feet in that short distance. The drainage area of the river above the falls is some 6,000 odd square miles. The maximum flood discharge is close on 250,000 cubic feet a second, the ordinary discharge during the rainy season is 180,000 cubic feet a second, and the lowest recorded discharge during the extreme dry season is 95 feet.

It has long been recognized that here was a source of power which it would be almost criminal not to utilize. But, unfortunately, there have hitherto been serious drawbacks to all schemes for the use of this power running to waste. The falls are situated in an out-of-the-way corner of the state, far from the railway, and the climate is so unhealthful that it was out of the question to establish factories close to the source of power. A couple of years by, however, a Royal Engineer officer, whose services had been lent to the Mysore state, conceived the idea of utilizing the power at the Cauvery Falls to run the Kolar gold fields, 90 miles away, in a direct line.

The Works of the Eddy Electric Manufacturing Company.

A Model Establishment for Making Direct-Current Apparatus—Description of the Works of the Company and of Its Modern Methods of Manufacture.

One of the best-known and one of the earliest organizations to enter the field of electric motor and dynamo manufacturing was the Eddy Electric Manufacturing Company, at Windsor, Ct., about six miles from Hartford. In buildings conveniently situated with reference to shipping facilities, this company located its factories some 15 years ago, and has several times enlarged them. Its high-class product has won for it an enviable reputation not only in this country, but in many foreign centres. The plant is well compacted in one large main building with several smaller buildings, an excellent idea being given by the illustration above of the general arrangement of these structures.



Works of the Eddy Electric Manufacturing Company at Windsor, Connecticut.

The main building is in two parts, one having a half-basement with one large room above it, lighted from side windows, and an attic above, the other part having two full stories above the half-basement. At one end is a brick building used for office purposes, having two stories, the upper portion being given over to the draughting room and to the engineering force.

The product of the Eddy company consists of dynamos and motors for direct current in sizes up to and including about 250 kilowatts. In addition to this, a particular specialty is made of the manufacture of dynamos for electroplating, the company having been one of the early pioneers in this special field of electrical work.

In the basement, which is excellently shown in Fig. 2, is conducted the work of the manufacture of shafts, bearings and commutators. This department is equipped with machinery of the most modern type. Here, also, some small portion of the heavier work on machine bodies is done, but for the most part this department is given over to the three uses specified above. In the construction of commutators the company has advanced the principles of standard practice to a considerable degree. The commutators are built up from copper bar of standard taper, cut off to proper length and heavily insulated with mica. The commutators are assembled in contracting rings, and are turned up in bulk and finished on the lathe.

In all of the machines made by the company the standard design for bearings is the spherical self-aligning bushing, properly lined with babbit metal. These bearings and journals are made in the same department, and here, also, shafts are turned for motors of all sizes. The company's requirements in the direction of accuracy in this work are very specific, as the product is carefully standardized throughout and no deviation anywhere from accepted sizes is permitted. Below will be found some account of the company's work in this connection.

The main machine floor is that under the truss roof, and here are gathered the heavy machine tools for work upon motor and dynamo frames, as well as lighter machines for smaller work. One of the illustrations gives an excellent view of a 60-inch planer in one corner of this shop and also shows an ingenious system of trolleys adopted for handling work in the shop. Another view shows the smaller machine tools on the same shop floor.

On the long main floor work is arranged so that castings are received at the end nearest the office, and progress steadily along the building to bring up at the storeroom after having passed through the testing department. The extreme standardization practised by the company has made it possible for it to manufacture parts in great numbers and store them ready for assembling, or else store assembled machines of standard sizes finished and ready for shipment. On this account the storeroom is unusually large, and great care has been taken in its management to tabulate strictly and keep account accurately of all that it contains, so that it is a matter of a few moments to discover how much of any particular vari-

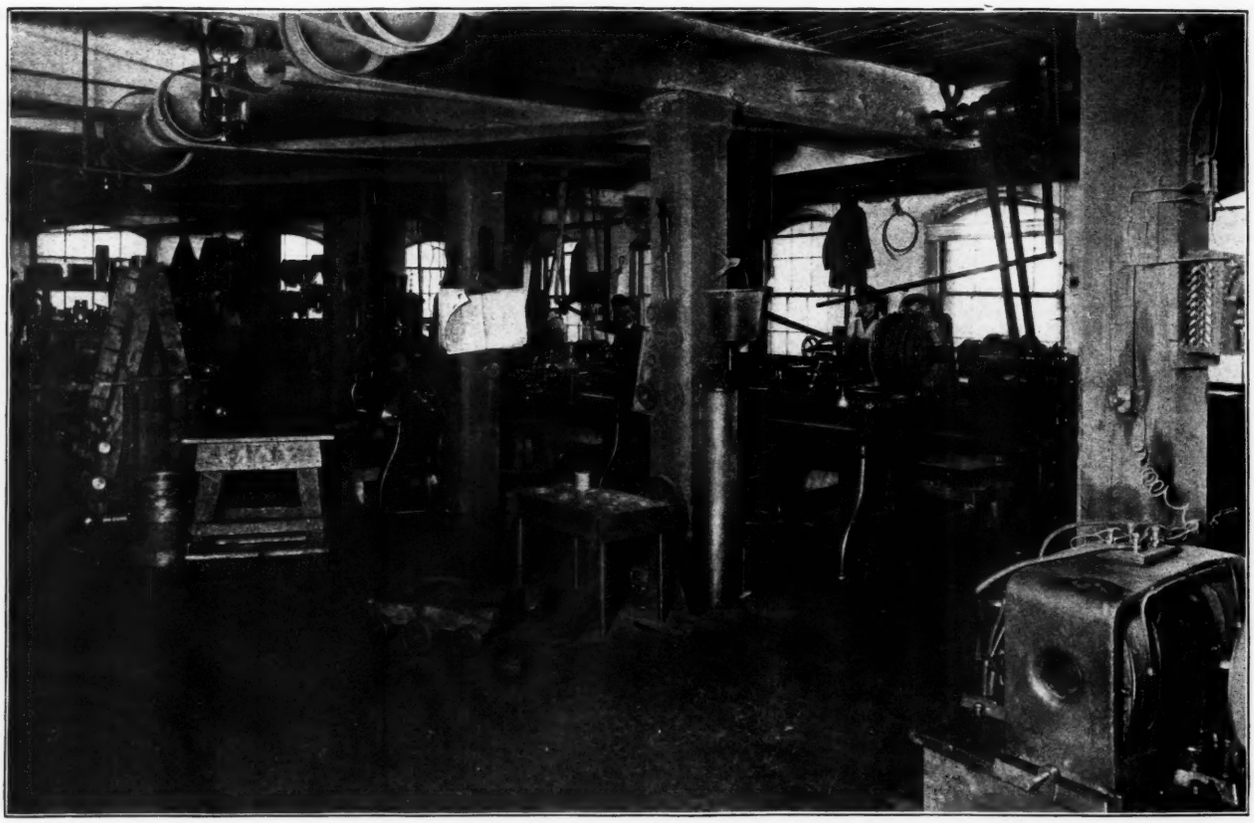
ety of part or of finished apparatus is in stock.

On the machine floor numerous mechanical processes of considerable interest are carried out. Among others, the process of slotting the armature cores for the company's machines is one of particular attractiveness. The design of these cores is such that they contain many parallel-sided slots of considerable depth, leaving teeth of about the same size as the slots between the latter. After numerous experiments in making dies and punching all of the slots at once, or in gang punching, the company made experiments to see if milling were not as efficient a mechanical operation as punching for this purpose. It was found that an automatic milling machine could be made which would take the assembled armature core, the disks used being plain circular disks, and mill out the necessary slots in it in less time than they could be punched by any punching process that was available. In assembling the armature for this purpose, the disks are put together with thin paper between them, and a sharp milling tool is used, running at a high speed and resulting in an excellent, clean cut without burs. The edges of the slots are trimmed by means of hand-filing after this operation is completed, and any "feathers" of paper left sticking out are burned off with a gas flame.

The winding department is on the upper floor of the three-story building, and a small part of it is well illustrated in the engraving. In this department the coils are wound, and here also the cores are brought for the application of the winding to them, though some of the larger ones are wound on the floor below. In the usual direct-current work a very simple form of winding is used, resulting in an armature that runs in excellent balance mechanically, and yet possesses much strength on account of the deep slots and the interlocked nature of the winding. Over the winding, when finished, a binding of thin steel wire is run, it having been discovered that the steel binding is of considerable value in reducing eddy currents and losses in the iron and copper of the armature, and actually resulting in an increased efficiency which is distinctly measurable in the test room.

All of the output of the Eddy shops is carefully examined for accuracy in construction and efficiency in performance in the test room which forms part of the main floor, and to which is brought current of all the voltages concerned. All machines are given a severe service test, under as nearly as possible service conditions, for 12 hours or until perfection is assured.

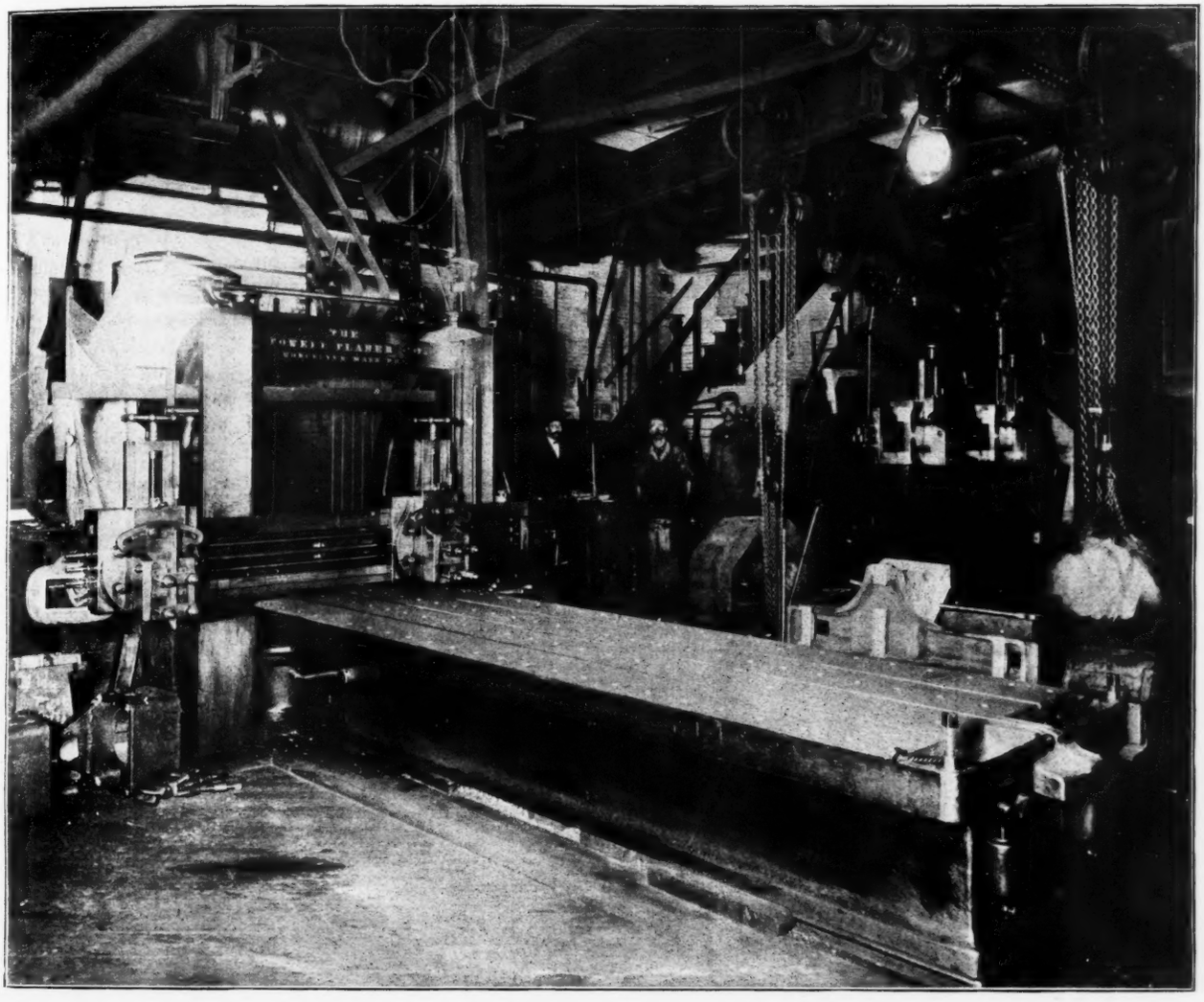
An interesting feature of some of the machines made by the company is a duplex commutator. This commutator is made up of twice the usual number of bars, the winding being so arranged that by connecting bars across the commutator, one with another, a very small variation in voltage from bar to bar is attained, resulting in sparkless commutation, easy running, and long life. It should be said here that both radial and reaction type brush-holders are employed on the machines made by the company, the preference being exercised by the consumer.



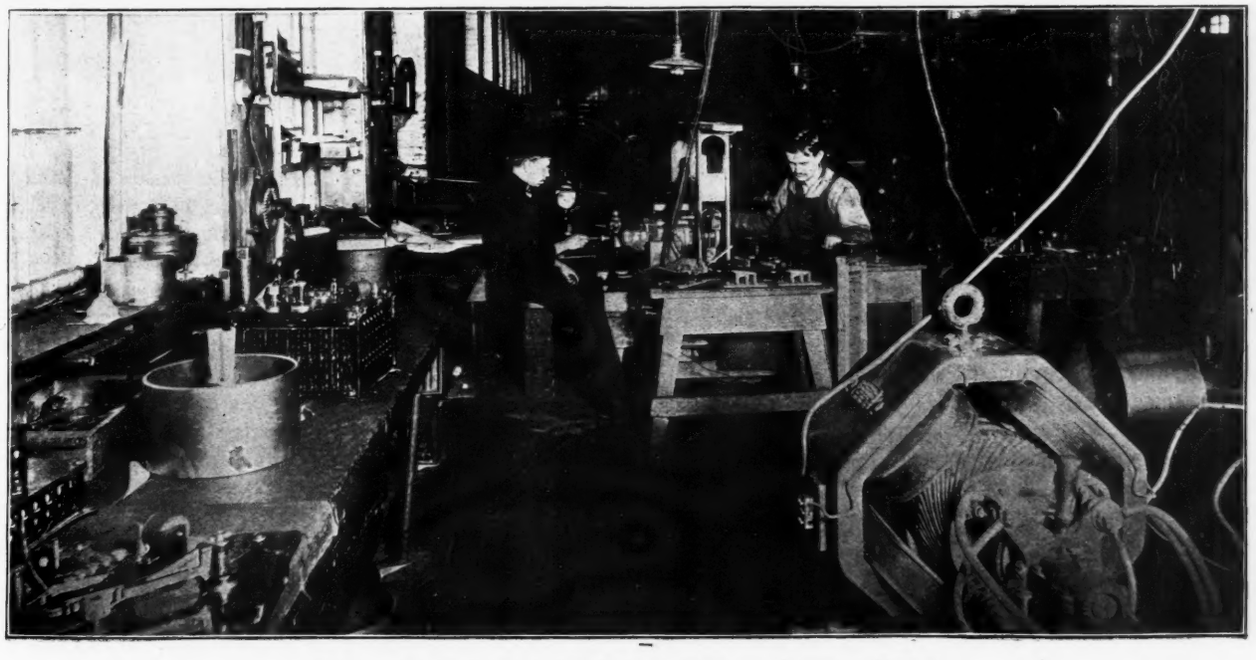
The Commutator Department of the Eddy Company's Works.

As mentioned above, a considerable part of the output of these works is in machines for electroplating, or machines giving very large currents at small voltages. It is usual to wind the armatures of this apparatus with heavy copper bars, and one of the standard types has a commutator at each end connecting with two separate windings on the armature, and so arranged that the leads from them may be connected in series or parallel, thus giving a considerable range in voltage and output.

Some very interesting experiments have been made during the last several years



One of the Large Planers in the Eddy Company's Machine Shops.



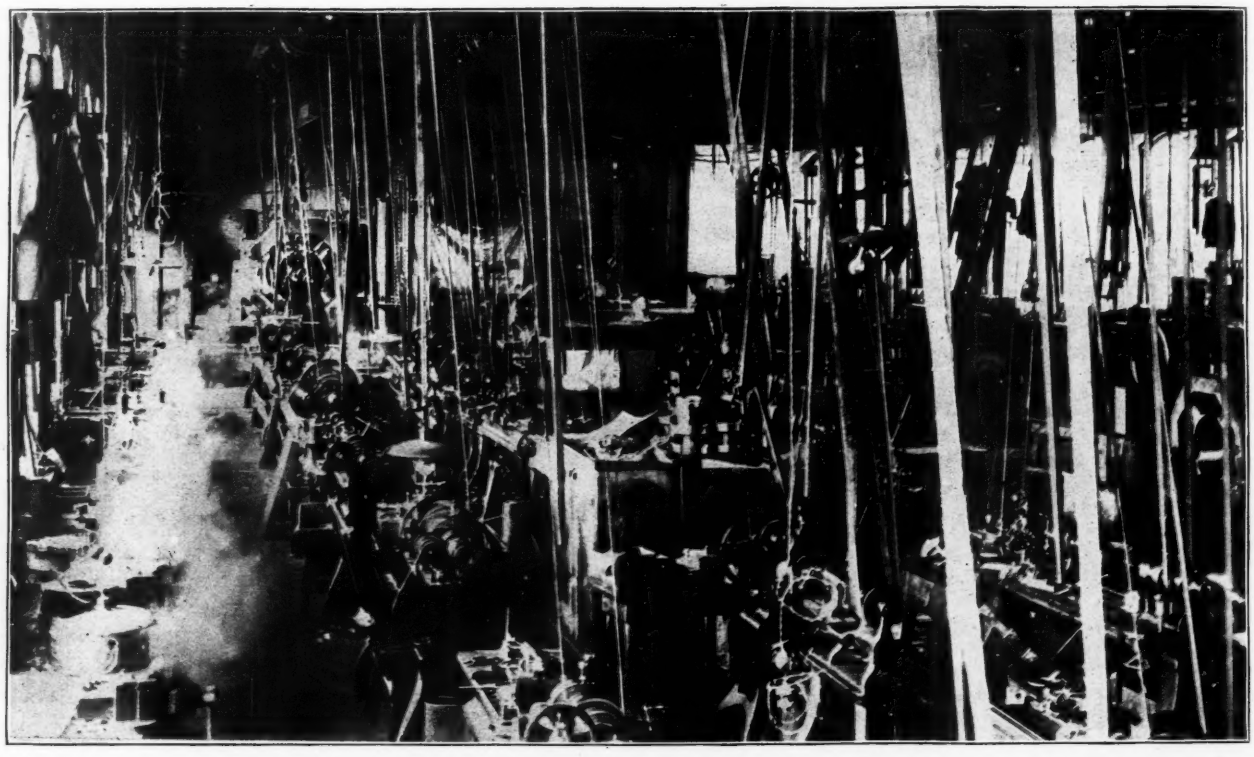
View in the Eddy Company's Testing Room for Carriage Motors.

with the unipolar dynamo for this purpose, and the Eddy company believes today that it is the only concern which has built and actually sold a unipolar dynamo for practical work. Such a machine was made several years ago for a large electroplating establishment in New England, and is still in active operation. Mr. H. E. Heath, the Eddy company's engineer, has paid particular attention to this class of machine, and has attained such experience in building unipolar apparatus that he has confident hope of its eventual use in the arts.

For some time past the company has been interesting itself very closely in the development of the electric automobile, having set aside the electric motor for this purpose as its particular sphere of operations. A type of enclosed slow-speed motor, resembling very closely a small street-car motor, was devised, and elaborate experiments undertaken to secure data both for the perfection of the type of motor and the adoption of standard sizes and speeds. Here, as elsewhere in this company's work, standardization has been most closely applied, and the automobile motors turned out by the concern are today made in standard sizes and speeds, seven styles being manufactured. Controllers for these machines are also made in the shops at Windsor, and running gear for automobile vehicles is also being manufactured there.

Notwithstanding the great extent to which standardization is practiced in these works, the piece-work system of payment is used only to a small extent, the wages of the men being paid by the day as usual.

About 200 operatives are employed. The factory is particularly light and well ventilated, and an inspection of the accompanying illustrations will show that attention has been paid to these important essentials of factory management, and the comfort of those engaged in the work of production. The close combination of the works' office with the works themselves, the excellence of arrangement of the shops, which enables close inspection to be given to every detail of the operations conducted in them, and the concentration that is possible in works of this character, makes this establishment one of the most effective for electrical manufacturing work. It is useless here to speak of its output in more specific terms, as this has been known to electrical people ever since the beginnings of modern electrical engineering. The Eddy company has continued under the same management, without reorganization, from its first day of business.



GROUP OF SMALL MACHINE TOOLS IN THE EDDY COMPANY'S WORKS.

Wire Wanted in Turkey.

A Constantinople subscriber of the ELECTRICAL REVIEW, Mr. Alex Philippakis, Emin Bey Han, No. 17, wishes to receive price lists from American makers of galvanized-iron telegraph wire, submarine cables and telegraph poles.

Mr. Riker's Lecture on Automobiles.

Mr. Andrew L. Riker delivered a most interesting lecture on the electric automobile, its cost, operation and management, before the members of the Automobile Club of America, Tuesday evening, March 26. Mr. Riker's lecture was the third of a series of talks inaugurated by the club on motor vehicles.

Apart from the pleasant way Mr. Riker delivered his address, the most interesting feature of the discourse was the presence of the actual parts which go to make up the electric vehicle. Two complete running gears, one fitted with the single motor and the other with the double-motor equipment, were used in illustrating the transmission of power devices. The system of speed control was shown by connecting up the various parts of a vehicle after they were fastened in their proper positions on a board backing.

Naturally, a large proportion of the evening was spent in a discussion of the storage battery. Mr. Riker entered at some length into this question. He believed that an electric vehicle should give full satisfaction, and would if properly cared for. The club members displayed great interest in the subject.

Messrs. G. R. Ford, A. H. Danford and F. E. Bush, recently organized the Ford Automobile Boiler Cleaner Company in St. Louis for $200,000.

PERSONAL.

Mr. Charles T. Yerkes, of New York, is reported to have taken a hand in letting the contract for the Metropolitan Underground Railway, of London, England, and it is stated that his efforts have upset the plan to give the Ganz company the contract. The British Westinghouse Company, Limited, has put in bids for alternating and direct-current installations.

Mr. A. A. Thresher, of the Thresher Electric Company, Dayton, Ohio, who has been in the East looking after the fine installation of his company's machinery at the Brooklyn Navy Yard, has returned to Dayton. The recent loss by fire in his factory was fully covered by insurance and prompt action has resulted in the company now being able to fill orders as before.

Mr. Thomas A. Edison returned last week from the South, much benefited by his month's vacation. Several important inventions will keep the distinguished electrician closely at work in his laboratory at Orange, N. J., for a considerable period. Mr. Edison stated on his return that he had so many things he wanted to do that he didn't know which one to start on first.

Mr. W. A. McKenney, of the well-known electric fixture house of McKenney & Waterbury, Boston, Mass., was a New York visitor last week. Mr. McKenney reports increasing activity throughout New England in his field of manufacture, and predicts that the first year of the new century will be one of the most prosperous in electrical history.

Mr. Joseph H. McDuffie has recently associated himself with Mr. William E. Metzger in the automobile business at Detroit, Mich. Mr. McDuffie came into prominence at the recent automobile show in Madison Square Garden, New York, by driving his machine in a sensational manner up the prepared incline on the roof of the Garden.

Mr. J. W. Boyle, of Utica, N. Y., has retired from the street railroad which he was instrumental in developing in that city. Mr. Boyle recently succeeded in carrying to a successful ending the turning over to a syndicate of the controlling interests in the Belt Line Street Railroad and its suburban connections.

Mr. Thomas Wood, the general manager of the Sandusky, Ohio, & Interurban Railway Company, has been appointed recently to succeed Mr. M. C. Schmidt as general manager of the Sandusky, Norwalk & Southern Railway, this company recently having passed into the hands of the Everett-Mahler Syndicate.

Mr. Charles L. Henry, who recently resigned from the general managership of the Union Traction Company, of Anderson, Ind., expects to take the first vacation he has had in 10 years within a few months, when he will visit Europe, spending considerable time there.

Mr. Hugh J. McGown, the president of the Indianapolis, Ind., Street Railway and of the Cincinnati Traction Company, is seriously ill at his home in Indianapolis. Mr. McGown is one of the best-known street railway men in the country.

Mr. William L. Keplinger, recently of Philadelphia, Pa., is now filling the post of general superintendent of the Sunbury & Northumberland Electric Railway and Lighting Companies, of Sunbury, Pa.

A Corner in the Winding Department of the Eddy Company's Works.

Mr. R. T. Paine, the president of the Tacoma, Wash., Railway and Power Company, is visiting New York, and has his headquarters at the offices of the General Electric Company.

Mr. A. W. Clark, president of the Butte, Mont., Electric Railway Company, sailed for Europe a few days ago, where he will remain for some time on a vacation.

Mr. J. A. Shepherd, the New England sales agent for the Stirling company, has returned to Boston after a visit of a few days in New York city.

Mr. George Wood, of Sandusky, Ohio, has recently been appointed superintendent of the Interurban and White street railway lines in that city.

Electric Railways

The projected trolley railroad between Hagerstown, Md., and Boonsboro is an assured fact and it is stated that cars will probably be run by July 4, as the rights of way are nearly all secured, the surveys completed and the required cash for constructing the road available. Before the line is finished it will have cost in the neighborhood of $200,000.

At the annual meeting of the Albany & Hudson Railway and Power Company, which operates the new third-rail electric road between Albany and Hudson, at Hudson, April 2, the following were elected directors: Clinton L. Rossiter, formerly president of the Brooklyn Rapid Transit Company; Foster M. Voorhees, of New Jersey; Henry Siebert, W. F. Sheehan, R. A. C. Smith, Seth L. Keeney, of Brooklyn; A. M. Young, of Branford, Ct.; James Purcell, of Hudson, and H. G. Runkle, of Plainfield, N. J.

Albert L. Johnson, the well-known electric railroad promoter, recently offered to build a tunnel in which he proposes to run electric cars from New York to Staten Island, by way of Brooklyn, to connect the New York and Philadelphia road which he is now working on with the New York Rapid Transit lines, offering a three-cent flat fare between New York and Richmond Borough (Staten Island), and unlimited transfers in Greater New York. In commenting on the proposition the New York *Commercial Advertiser* says editorially:

Mr. Albert L. Johnson's offers to extend the rapid transit tunnel from Manhattan Island through Brooklyn and thence by way of Bay Ridge across the bay to Staten Island, with provision for a uniform fare of three cents and unlimited transfers in the expanded city of New York, naturally attract attention on account of the magnitude of the proposals they contain. It will not do, however, to jump to hasty conclusions about them. The Rapid Transit Commission has met them in a fair spirit. In his letter to Mr. Johnson yesterday Mr. Orr laid down the terms on which any one might undertake the work roughly outlined by the loquacious contractor, and advised him to make an offer, if he was inclined for business, along the lines of the contract for the work in this borough. To this Mr. Johnson lost no time in replying. In twelve hours he announced that he was ready to accept all of Mr. Orr's terms; in a few days he would lay his plans before the board; he would make a contract for construction at the lowest possible figures and accept in payment such money as could be supplied up to the debt limit of the city, taking the rest out on his own credit, until the city could legally pay more, and would undertake to establish a sinking fund which would extinguish the debt on his lines within 25 years. All this is very fine and we earnestly hope that something will come of it.

Export Notes

Our exports to Europe, between the years 1890 and 1900, have increased from $682,000,000 to $1,116,000,000, or 63 per cent; to northern America, $95,000,000 to $98,000,000 or 108 per cent; to southern America, $35,000,000 to $41,000,000, somewhat less than 20 per cent.

"La Sociedad General Gallega de Electricidad" is the name of a new company which has been formed with a capital of 2,000,000 pesetas at Madrid, Spain. The object of the company is to utilize the waterfalls at Segad and Ferranza, and also to construct a central electric-power station at Caldes de Reyes.

Exports during the month of January from the United States were valued at $136,317,354, an increase of $18,720,206, while the imports amounted to $69,100,194, or $6,796,908 less than the amount for the same month of 1900. For the seven months ending January 31 the exports increased $102,183,243, aggregating $902,229,729 and leaving a balance of trade in favor of the United States of $443,398,658.

For the year 1900 the mineral exports of the United States, including gold and silver, amounted to $436,227,477, or 28 per cent of the total exports of domestic products. The classification is as follows: Iron and steel, $130,000,000; mineral oils, $75,000,000; copper, nearly $60,000,000; gold, $52,787,523; silver, $59,272,868; coal and coke, more than $22,000,000; paraffin, somewhat over $8,000,000, and phosphates, over $5,000,000. The iron and steel export trade of 1900 is nearly five times that of 1890, and the total figures show an increase of $295,780,373 over the figures for 1890, which were $140,447,104.

A recent issue of the "Bureau of American Republics" states that of the exports to Pan-America, drugs, medicines, machinery, brandy, flour, cotton-goods, manufactured iron, and material for railways, telegraph and general electrical goods are largely imported from the United States. The other countries represented are France, England, Germany, Japan, China and Italy. Glassware, crockery and terra-cotta come from the United States, France, Belgium and Germany; silks, according to the quantities furnished, from France, United States, England, Germany, Japan, China and Italy. The greatest activity is manifested in cotton and woolen goods, liquors, machinery and electrical supplies, in all of which the United States is heavily interested. Most of the electrical goods come from this country.

Telephone and Telegraph

The Kingman, Kas., Telephone Company has been chartered with a capital stock of $3,000, its principal backer being B. Albaugh.

A new telephone company has been incorporated in Bloomfield, Ind., by John F. Slinkhard, G. H. Hendron, Ziba P. East and others, for $15,000.

The Olds, Iowa, Telephone Company has recently been incorporated for $1,800 by H. K. Smith, J. W. Brown and others, to operate a local service.

Articles of incorporation have been filed by the Maquoketa Telephone Company, of Iowa. The company was incorporated by H. T. Brigham, C. B. Miller and others, for $45,000.

Reports from Kokomo, Ind., state that the Jay brothers, of that city, have recently purchased an interest in the Kokomo Independent Telephone Company's plant, which, when completed, will cost $50,000.

Several gentlemen of Montgomery City, Mo., recently incorporated the People's Telephone Company, of Montgomery County, with a capital stock of $3,100. The organizers are H. Ellis, T. Marlow, W. Crane and others.

Recent incorporations in Iowa include that of the Spencer Telephone Company, which was chartered for $15,000 a few days ago, and the Corning Telephone Company, organized by J. A. Anderson, Frank L. Mercer and others, for $10,000.

The Western Telephone Company has recently acquired the entire stock of the Iowa & Nebraska Telephone Company, the consideration being named as $100,000. The exchanges included are at Sheldon, Sibley, Easterville, Spirit Lake, and Cherokee.

John I. Sabin, president of the Pacific States Telephone Company, which company holds the records for Bell telephone progress, says: "We will close March with 24,000 stations connected in San Francisco, making a net gain of over 1,500 for the month, in addition to which we have 500 unfilled orders. This telephone business needs first—general consolidation, general enthusiasm, fewer high-class blue prints and more common every-day arithmetic, fewer wheel horses to hold back in the traces and more broncos to put in the lead. For your information, a bronco is a wild Mexican horse that it takes 14 men to hitch up and once started he never goes at a walk until he dies."

Spring Construction Work.

As soon as the frost is out of the ground and the better weather of the Spring begins there comes a rush of activity in electrical constructing circles. At this writing gangs of men in hundreds of places, scattered throughout the country from the Atlantic coast to California and from Canada to Mexico, are busily engaged in stringing wires or laying track or building power-houses or telephone exchanges.

In the telephone line great activity is already noticeable. A particular direction in which this is manifested is the formation of farmers' cooperative systems, community systems and the introduction of telephone exchanges in small villages and "neighborhoods." The independent companies are still keeping up the astonishing growth which has marked them since the inception of the movement, and are looking forward to making greater gains in mileage of wire, number of exchanges and number of stations connected this season than ever before. Their lines cover the middle western states with a close network, and this seems likely to be considerably extended during the Summer of 1901.

The American Telephone and Telegraph Company, which is the successor of the old American Bell Company, is preparing to build this Summer a very considerable increase in its long-distance lines, probably using immediately in some directions the recent valuable patents acquired from Dr. M. I. Pupin. The same interests, represented by the licensee Bell companies, are carrying out the policy, which has been adopted by several of them, in altering their exchanges in the largest cities to the new system using the common battery, and a large expenditure is being made to carry into effect this desirable change. In New York city it is believed that the end of the year will see the whole system changed over, while in other cities work is actively progressing on the transformation, and vast extensions of lines and central office equipment are under way.

The growth in electric lighting is especially noticeable in the small cities and towns of the interior. In noticing the announcements of the formation of corporations which are published weekly in the ELECTRICAL REVIEW, one is struck with the large number of small electric lighting companies now being organized, many of them with small capital and located in places of a few thousand inhabitants. This is a symptom that the electric light is no longer regarded as a luxury, or a metropolitan privilege, but that it has become an actual necessity even in small towns and places where nothing stronger than the feeble ray of the oil lamp has hitherto illuminated the darkness of night.

In the greater cities the construction work of the electric light companies is largely in the nature of extensions of systems already installed and of alterations in the method of generating and distributing electricity for lighting and power purposes. In many places the polyphase system is being installed in single large central stations, conveniently situated with reference to fuel and water supply rather than with reference to the centre of distribution of lighting. In a large number of places such stations have been put up and existing stations have been turned into transforming and converting substations for supplying the variety of current necessary for the company's customers.

Very noticeable improvements are being made in towns of medium size and in the larger cities by the addition of storage battery plants to existing lighting equipments and, in several cases, the installation of a high-tension, direct-current system using high-tension lamps. The whole industry of electric lighting is in a healthy and prosperous condition and no small amount of capital is seeking investment in it, as may easily be seen from the large number of incorporations and enlargements noted.

In still another direction there is much activity among electric light companies. Since the advance of the engineering art, permitting lights to be burned over a much larger area than heretofore by means of polyphase and converting systems, it has become possible to consolidate, in many cases, electric light companies whose stations were located too far apart hitherto to interfere with one another's territory. These consolidations have generally resulted in a distinct betterment of the service as well as in larger profit for those interested in the enterprise by the suppression of unnecessary expenses in operation.

In the electric railway field there is every evidence of the widest activity and the most pronounced growth. Consolidations are being made which are resulting in extending lines from city to city over distances of many miles, sometimes of several hundred miles. In order to complete the linkage of widely separated points by electric tracks a large number of extensions are being undertaken and many new links are being built. Coincident with this, power-houses are being altered in order to take advantage of the wider distribution possible with alternating current, for the same reasons noted above in connection with electric lighting.

The most interesting extension of electric railway service noticeable at present is the increasing size and power of systems already in operation, and the exploitation of other and larger systems tending almost, in some cases, to the dignity of main-line railroads. The standard electric motor car for interurban service has grown to be a large and powerful vehicle, while the track work being put down is more and more approaching the standard specifications for steam railways. Particularly in the middle western states is this great extension of interurban railroading noticeable, although some lines are about to be constructed in the southern states, where they are relatively few at present, and the Pacific coast is also about to be well supplied with electric transportation facilities. In New England there is a great and increasing activity in this direction. In the city of Boston the thoroughgoing improvements for some time under construction in the street railway system of the city in its suburbs are nearing completion. In New York city such rapid advance has been made upon the construction of the Rapid Transit subway that already it is reported that 17 per cent of it is finished. It is rumored that a certain large steam railway system will begin work this Summer on the electrical equipment of a difficult portion of its main line, extending more than 100 miles and handling as heavy freight and passenger traffic as any to be found in this country.

In addition to all this work of extension, the lines of many electric railways are to be rebuilt this Summer with heavier rails to take care of increasing traffic and to permit the use of heavier cars. It is hard to specify any place in which this railroad building activity is more pronounced than another, but it is evident from the formation of new corporations and the consolidation of existing ones that the middle states are an exceedingly active field for electric railway work at present.

The advance in the electric automobile industry is set forth at some length in

other pages. In some of the minor departments of electrical engineering excellent progress is being made also, as, for example, in the character and solidity of house wiring as it is now installed, and in the relative position of importance which the electrical auxiliaries of buildings have now attained in the estimation of architects and owners. A considerable industry in conduits or tubes for interior wiring has grown up within the last few years and promises to increase greatly when the demand for this Summer's construction work is felt.

The manufacturers of wire—copper, aluminum and iron—are looking forward to an exceedingly prosperous season on account of extensions and new undertakings. Very large quantities of cable are being manufactured for conducting high-tension currents underground in connection with the distributing systems for light and power mentioned above. In addition to these, the high tensions involved in long-distance power transmission have brought out new types of cable and aerial wires, many of which will be tested in practice before the next Autumn.

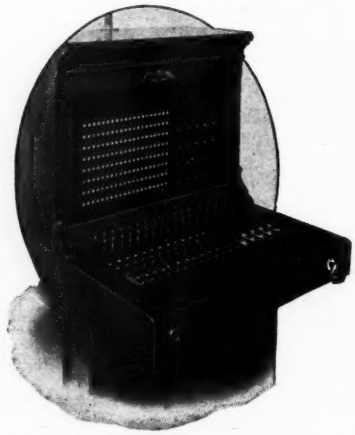
Great activity is noticeable in several parts of the country in power-transmission enterprises. The Pacific coast is rapidly becoming an electrical neighborhood, several important installations being under way in California, Oregon and Washington state. Among them are some that are destined to be famous monuments of engineering progress, in that they are the longest power transmissions in the world and employ the highest voltages in commercial use. A gratifying activity in water power and electric transmission projects is noticeable also in the southern states, where the aid of electricity is being called in to the service of many enterprises for the development of the magnificent natural resources of that portion of the country. Fine new plants are to be erected at a number of points and old ones will be enlarged.

This brief summary shows that the outlook at the beginning of the Summer season is particularly gratifying. In no department of electrical work does there seem to be either a stringency of money for the carrying on of operations or a lack of enterprise and interest. There has been no backward step taken anywhere along the line, and all of the various branches of electrical engineering work show indications of widespread and continuing prosperity.

The St. Petersburg, Ga., Telephone Company h s recently been incorporated by T. C. Parker and others, for $10,000.

Small Central Energy Switchboards.

The recent increase in the demand for central energy apparatus and switchboards for use in small exchanges has led to the development of a line of apparatus especially designed to meet this demand. The use of central energy systems in large exchanges has proven conclusively that this system is destined to play an important part in the telephone industries of the immediate future. By this method all current for both talking and signaling is supplied from one central battery located at the exchange. By its use the troubles incidental to many small batteries at the



COMBINATION SWITCHBOARD FOR CENTRAL ENERGY AND MAGNETO LINES.

subscribers' stations are done away with and the single large battery, which is placed where it is easy of access, also increases the efficiency of the system. The use of lamp signals has also come to be so generally adopted in recent exchanges that this system will doubtless eventually supersede the mechanical signals now so generally in use.

The switchboards recently put upon the market by the Kellogg Switchboard and Supply Company, of Chicago, for use in exchanges having 200 lines or less, combine the excellence of design and workmanship which has characterized the larger switchboards installed by this company, with small size and an adaptability to the varying conditions of operation which are found in exchanges of insufficient size to require a multiple board. Lamp signals are used throughout, both for line signals and for a double supervisory system, which keeps the operator informed at all times of the condition of any pair of connected lines without the necessity of listening in and enables her to handle twice as many lines as was previously possible. The wiring throughout is of the best silk and cotton insulated wire, made at the company's own factory, and soldered without acid. All wiring is brought down to a connecting rack in the rear. The cabinet work is of highly polished quartered oak.

A combination switchboard for both central energy and magneto lines is shown in the accompanying cut. In addition to 160 central energy lines, as above described, 20 mechanically self-restoring drops and jacks are added for toll-line work, having tubular clearing-out drops associated with them. The remainder of this equipment consists of 18 pairs of plugs and cords, with cam combination ringing and listening keys, one operator's circuit with receiver and transmitter and night circuit. The supervisory lamps for use with each pair of cords are shown mounted in the keyboard immediately in front of corresponding plugs. This board furnishes a high-class equipment for a reasonable outlay.

OBITUARY.

Mr. Charles A. Munson, Chicago manager of the Fort Wayne Electric Works, died in Chicago, April 4, after a surgical operation necessitated by a long illness. Mr. Munson was born in Fort Wayne in 1843, and, like many other men who have since attained prominence in the electrical field, he began his career as a telegraph messenger boy. He served with distinction in the United States Navy during the Civil War, becoming a third officer before he was 20 years old. Engaging in general business for several years he entered politics for a short time and upon the close of his political career he entered upon the duties of the office of Chicago manager for the Fort Wayne works. Mr. Munson was a genial and kindly man, whose friends are numbered by the hundred throughout electrical circles in this country, and his loss will be felt by many among his friends and business associates.

Captain William M. Marsh, treasurer of the Omaha, Neb., Street Railway Company, died of consumption recently, at Nassau, N. P., at the age of 69 years. Captain Marsh was also president of the Union National Bank of Omaha, and one of the leading financiers in Nebraska. He is survived by four sons, all business men of Omaha.

Colonel George B. Cowlam, of Madison, Ind., died of apoplexy in New York city recently. Colonel Cowlam was chief telegrapher of the army under General McClellan during the Civil War, and it was he who first described over the wires the fight between the Merrimac and Monitor in Hampton Roads.

General Charles Coffin Fry, manager and secretary-treasurer of the Lynn, Mass., Gas and Electric Company, died in that city on March 21, the cause of his death being pneumonia. General Fry was born in 1842 at Lynn, where he resided all his life.

Mr. S. J. Reeves, late treasurer of the Dover Construction Company, which is building and financing the Toledo, Findlay & Fostoria, Ohio, Electric Railway, died recently at his home in Canal Dover, Ohio.

A New Departure in Chandelier and Ceiling Fan Combinations.

The accompanying illustrations show exterior and sectional views of an interesting and novel combination ceiling fan and chandelier made by the Boston (Mass.) Electric Heating and Power Company. Fig. 1 shows an external view of the combination, while in Fig. 2, to the lettering of which reference is made below, is shown the interior and working parts.

A represents the ordinary wrought-iron pipe hanger enclosed in polished brass tube. Below the pipe hanger the spun brass casting of the motor and mechanism is shown in a lighter tint.

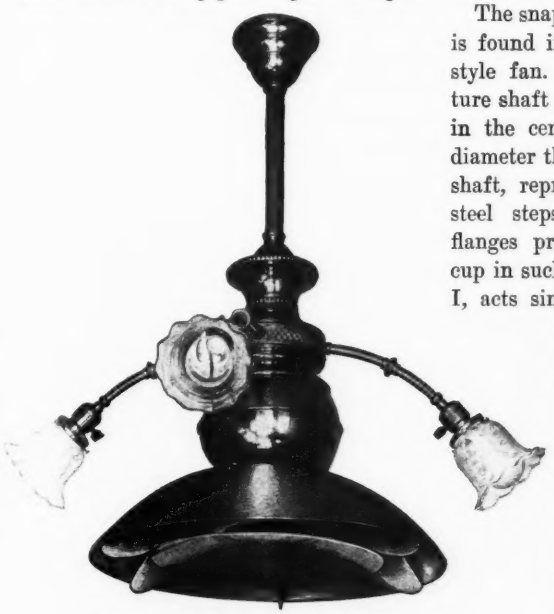


FIG. 1.—CHANDELIER AND CEILING FAN.

B is the yoke hanger, consisting of cap, pillars and base, which is attached by the means of screws to the upper end of the motor shell. The yoke carries a rheostat marked D, the snap-switch marked E, the electrical connections in the form of rings marked G, the upper or guiding bearing marked I, as well as the bracket arms of the chandelier, part of which is shown at K. To the bottom of the yoke is attached the motor, in the one shown a direct-current, series wound machine, but with the bearings adjusted for vertical suspension and revolution.

Below the motor, on the hollow shaft H, is attached the "new departure" centrifugal fan. Below the fan at its centre, projecting through the hollow shaft, is the spindle carrying the thumb-nut of the snap-switch.

C represents the wires from the line, in the illustration, cut off just above the switch. In practice these wires are connected by binding-posts, with the plus and minus rings, marked G. These rings are carried on the pillars of the yoke, but insulated from the same, and are fitted with binding-posts according to the number of arms in the chandelier. From these rings the current is carried to the motor and switch as well as to the lights in the brackets of the chandelier. The wires from the light bracket K, are shown at J. By this arrangement it will be seen that the wiring, which in a four-arm chandelier would be complicated and crowded, is much simplified, and the fan and motor may be operated independently of the lights, and *vice versa*.

The snap-switch gives two speeds, which is found in practice to be ample in this style fan. The bearings for the armature shaft consist of a cup, having a well in the centre one-eighth inch larger in diameter than the shaft. Attached to the shaft, represented at I and O, are two steel steps having downwardly curved flanges projecting into the composition cup in such a manner that the upper one, I, acts simply as a guiding bearing, as there is no friction at the bottom of the cup; while the lower one, O, being the working bearing, guides upon the sides of the cup, and rests upon a ground and hardened steel washer in the bottom of the cup.

These flanges are pierced by a suitable number of holes, so that any oil which might possibly work up the inside of the flange on to the shaft and thence down to the commutator, or the fan, is thrown by centrifugal force through the flange and out to the oil-cup wall. It will be seen by this that it is impossible for any oil to escape from the bearing. Oil tubes, shown at F and N, have dustproof caps and allow an introduction of oil at infrequent intervals.

The fan consists of two spun brass disks, Q and T. The upper disk, Q, is pierced in the centre allowing the air to enter at the inner end of the radial floats, S. The lower disk, T, is solid, and to it is attached the hub, P, which in turn attaches to the shaft of the motor by suitable means.

The floats, S, are six in number and are arranged in a vertical position radiating from the centre of the fan. These form with the disks, Q and T, a centrifugal fan of such shape that the air is delivered outward and downward in the form of a cone. The fan has two speeds, about 400 and 650 revolutions per minute.

The advantages claimed for this style of apparatus are compactness and beauty in a ceiling fan or chandelier, light current consumption and a large and effective distribution of air. It is stated that a 15-inch fan gives a distribution of air more than equal to the delivery of a 50-inch ceiling fan of the wooden blade propeller type.

General Electric Company's Statement.

The statement of the General Electric Company to the Massachusetts Commissioner of Corporations makes the following showing of assets and liabilities as of December 31. It is compared with balance sheet given in last annual report:

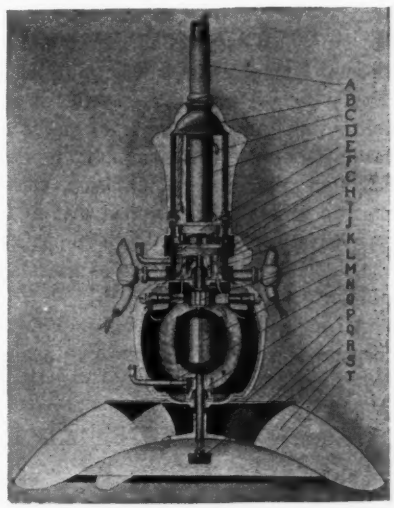


FIG. 2.—CROSS-SECTION OF CEILING FAN.

Assets.	Dec. 31, 1900.	Jan. 31, 1900.
Real estate	$350,848	$363,643
Patents, etc	2,000,000	2,000,000
Cash and accounts received	13,339,127	8,515,075
Inventories and work in progress	7,330,832	8,921,709
Plants, investments, etc	10,736,926	9,532,270
Total	33,957,733	29,532,697
Liabilities.		
Capital stock	23,750,000	20,827,200
Debts	1,599,179	1,052,466
Debentures	1,646,500	5,300,000
Profit and loss surplus	6,962,054	2,353,030
Total	33,957,733	29,532,697

From the above, says the *Boston News Bureau,* reckoning the dividends paid to stockholders during the year and interest paid debentures together with an increase of $4,600,000 in profit and loss surplus, the profits for the 11 months were, in round amount, $6,500,000, with one month's business to come in. This may be estimated at $500,000, though probably it was half as much again in January of this year, so that the profits for the year were apparently fully $7,000,000. This would pay 28 per cent on the enlarged capital after full retirement of the debentures.

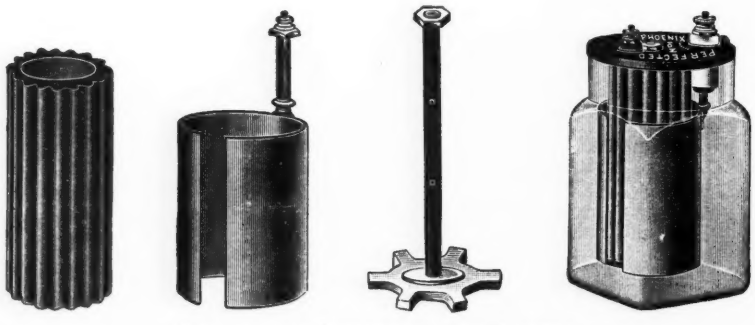
The profit and loss surplus on January 31 should, on the basis of the above figures, be about $7,500,000 upwards, less whatever amount may be written off. This is equal to about 30 per cent on the capital stock outstanding. The company could undoubtedly return 20 per cent in stock (one-half the capital reduction in 1898) to stockholders to-day if desired.

An Improved Type of Carbon Battery.

The new battery manufactured by the Booker Carbon and Battery Company, of St. Louis, Mo., and called by it "The Phœnix No. 1 Perfected Type," possesses several points of great ingenuity and novelty. By reference to the accompanying illustrations the general arrangement of the parts of the cell may easily be understood. The cover is removable and is so treated that it is impossible for moisture to reach the metal connections. As is well known by users of batteries, one of the chief troubles and defects of the ordinary wet battery is the creeping of crystalline salts and the corrosion of the metallic electrodes on this account, resulting in high resistances and back electromotive forces. It is claimed that in this new battery this trouble has been obviated, the method used being one of great simplicity.

All objectionable soft rubber parts are dispensed with. The zinc lug projects through the carbon cover of the cell, being protected by a square porcelain bushing, having a square hole in it which fits the square lug. This construction holds the zinc rigidly in place and in proper position in reference to the carbon. The bottom of the carbon electrode is a porcelain rosette, which acts also as a fender for the zinc, the latter being thus held rigidly both at the top and the bottom. On this account it is claimed that a short-circuit is practically impossible. To bind the porcelain bottom and the carbon cover piece together a hard-rubber bolt is used. This is hollow and perforated so as to allow the ammoniacal solution to come into contact with the depolarizing filling in the inside of the carbon cylinder and at the same time to allow free vent for the escape of any gases that may be engendered in the operation of the cell. Careful attention has been paid to all the details of the manufacture of this battery, and it is shipped in such a way as to make an error in setting it up practically impossible.

The officers of the Booker Carbon and Battery Company are Colonel S. G. Booker, president, and Mr. Henry Wrape, vice-president. The company is well financed, and has valuable facilities in the way of a well-equipped plant for the production of carbon products. A large part of such machinery needs to be specially designed for carbon work, and the foundation and laying out of a carbon factory entail much expense, with a complete practical and technical knowledge of the carbon industry. Colonel S. G. Booker, the president of the company, is widely known as a pioneer and expert in the carbon and electrical industry, and, as will be remembered, was formerly president of the Phœnix Carbon Manufacturing Company.



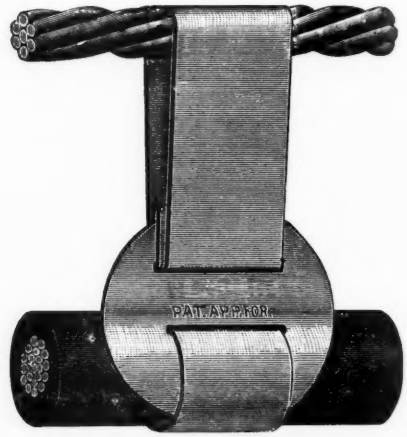
Details of an Improved Carbon Battery.

Lower River Power and Water Supply Company, at Niagara Falls.

A bill was recently introduced into the Assembly of the State of New York, at Albany, incorporating the Lower River Power and Water Supply Company, at Niagara, N. Y., with a capital of $500,000. The incorporators are Commodore P. Vedder, T. J. Bergen, William Williams, C. K. Hotchkiss, De W. V. D. Reiley, T. F. King, George W. Knowlton and J. S. Simmons. The company has authority to take water from the Niagara River and to develop and generate hydraulic and electric power and to supply it for all manufacturing and industrial purposes. It also has the right to transmit power to any town or city in the state at rates to be agreed upon by the local common council or the highway commissioners. The additional privilege of acquiring lands by condemnation proceedings has been granted the company and if it is considered necessary to cross a railroad with its tunnels, canals, raceways or other works, it has the privilege of doing so under the same conditions imposed by the law when one railroad crosses another.

Telephone Cable Clip.

One of the most recent improvements in accessories to telephone line construction is here shown in an ingenious cable hanger or clip, which is being marketed by Messrs. James S. Barron & Company, of New York. It is made entirely of one piece, and thereby obviates the danger of electrolytic action that is possible in other cable hangers that are made of several pieces. It also obviates the trouble that is experienced with hangers that have loose parts which may become misplaced or lost. The cable hanger illustrated is entirely made of zinc, being stamped out with one motion. It is claimed to be very simple and quickly applied. It will accommodate the several different sizes of cable. The illustration of the hanger here shown, represents it gripping a three-quarter-inch diameter cable. The



Improved Cable Clip.

illustration shows one way in which the hanger is applied; *viz.*, the circular enlargement at one end of the hanger is held against the cable, the free end is wound around the cable, passed through the lower slot, around the cable again, through the upper slot, up over the suspension wire and hooked into the upper slot.

Another application is to pass the free end once around the cable through the lower slot, up over the suspension wire and then hook it into the upper slot.

The makers state that the hanger can not possibly jump off the suspension wire, and that it grips the cable tightly and does not allow it to slip.

An order has recently been placed by the Kehin Electric Railway Company, of Japan, for a 150-kilowatt generator, a number of small motors, switchboard instruments and other accessories required for the extension of its power plant. The electrical apparatus is all of Westinghouse manufacture.

The Automobile Industry in the United States.

A Symposium Describing Its Present Condition—Descriptions and Illustrations of Various Types of Vehicles—A Brief Review of the Automobile Industry Abroad.

THE INDUSTRY IN BRIEF.

BY W. H. MAXWELL, JR.

The opening of a new season always has been a time of great anticipation and conjecture for those engaged in building motor vehicles. This year that feeling is greatly intensified over what it has ever been before. Wonderful advances have been made, new devices have been brought to light, the working parts of the different makes of vehicles have been simplified, until we now have automobiles which give satisfaction, both to the user and to those who created them.

As every great industry has been developed, so has that of motor vehicle construction. Long, wearisome years were spent in experimenting before an even partially satisfactory carriage or wagon turned a wheel with its own power. Out of the extremely large number of inventions patented, the greater portion were dismal failures when practically worked up. Perseverance conquered, however, and vehicles that would run began to make their appearance on the streets and roadways. New ideas sprang into being, and the successful devices of the pioneers in the field were rapidly assimilated and improved upon by their followers.

In this country the three types of vehicles—electric, steam and gasoline—seem to have been developed almost simultaneously. One thinker after another made a careful study of the situation, and each chose for himself that course of action which seemed to him most feasible. In this way each set of workers developed a specialty until they felt justified in offering the results of their labors to the public in order to learn what was to be the measure of reward for their unceasing toil.

Capitalists did not wait for the vehicles to search them out, but made haste to take up the more meritorious of the inventions offered. Companies large and small sprang into existence. Corporations with immense means undertook to market these productions of the inventors. Stimulated by this aid greater efforts were made to develop the perfect vehicle. Business methods superseded the spasmodic attempts of the individual, hampered in many instances by the lack of resources which could bring forth the best results.

At this point the general public took hold of the industry, first as a matter of novelty, then as one of utility. With leaps and bounds the construction of motor vehicles progressed. Improved types of machines followed one another in rapid succession, and were welcomed by the public in a hearty and substantial manner. The pleasure carriage was immediately adopted by a great following, and the motor wagon, to be used for goods delivery, carried its point without opposition and won instant favor.

The first flush of victory has been too much for many men, and it was also too much for the motor vehicle industry. Emboldened by their success, those engaged in the manufacture of vehicles carried on their operations on a larger scale than had ever before been attempted. Expenditures were made with little regard to immediate returns. Those who were paying for the development of the industry soon began to think it was high time that the efforts of those actively engaged in the work should begin to show some tangible returns. The vehicles were put in the hands of a great number of enthusiasts—well-meaning, no doubt, but who did not realize, in most cases, the necessity of giving an automobile the proper care. The result, which could not help taking place, soon showed the manufacturers their error. Vehicles which should have given perfect satisfaction failed to do so because, in most cases, the users were not capable of giving them the attention they required.

In order to counteract this tendency toward dissatisfaction on the part of the consumer some few manufacturers made the unwise attempt to dispose of their wares by means of misrepresentation. Pressed by the need of funds the unprincipled members of the industry acted in such a manner as to make their innocent brethren suffer with them. Happy it is that this class was small, and that it has, in most cases, been eliminated from the problem.

To-day the industry stands freed from the greater number of those who pursued such methods in their work. Inventions and experimenting, even in the period of greatest exultation, never entirely closed and they are now rapidly furnishing the solution of many of the most vexing problems which have confronted the manufacturer. Misrepresentation has, in most cases, stopped. The natural working of the law of the survival of the fittest has wrought a great change, and has shown those who could not get along on other lines that the industry contained no place for them.

The coming year is one which will be filled with great things for the automobile. In the electric vehicle we may look for distinct and enormous advances—in the construction of the storage battery. Claims are made, and have, to a great extent, been substantiated, for a battery which will give a greatly increased capacity for a much smaller weight. It does not seem, in view of the labor that is being expended on this one phase of electric vehicle construction, that it is too much to say that we ought this year to be given a battery which will drive the ordinary carriage 50 or 60 miles on one charge, and have an active and efficient life of at least two years under ordinary conditions. The great trouble has been that the users of electric vehicles have not seemed to realize up to this time that the storage battery is as much a piece of machinery as the motor, and so needs the same amount of care. In design and mechanical construction great advances are being made every day. From this point of view there is not the slightest doubt that the electric vehicle is already practically perfect. In pleasure carriages and commercial vehicles of this type compactness in construction and symmetry in design have been obtained to such an extent that there is no type of horse-drawn vehicle which has not been duplicated, and even improved on.

The steam vehicle is making enormous strides toward betterment in construction and mechanical detail. The pleasure vehicle is being made cleaner, handsomer and safer every day. Steam trucks now under construction will soon make their appearance on the streets of our cities,

and make an active bid for the haulage of heavy freight wherever economy, cleanliness and expedition are desired.

In the field of the gasoline automobile, as well as in those of the electric and steam carriages, substantial advances can be safely predicted. Many brilliant minds are working on the solution of the problems which stand in the way of the perfect autocar, and it would be unwise to think that this or any other type of machine will not have reached a higher point of efficiency at the end of this year than it held at the end of nineteen hundred.

Never before has the general public been so interested in the automobile. The inquiries concerning the different types of carriages, wagons and trucks are legion. The solution of the problem of transportation without tracks is being slowly solved, and this year should see a great number of the hindrances which stand in its way absolutely removed.

Credit is due to those who, by the expenditure of their strength and effort, have brought the automobile to its present stage of perfection, and the time is not far distant when the difficult places, having been made easy, those who aided in the work will be honored and praised by all, each for the part he has taken and in due proportion.

The Wiring Connections of an Electromobile.

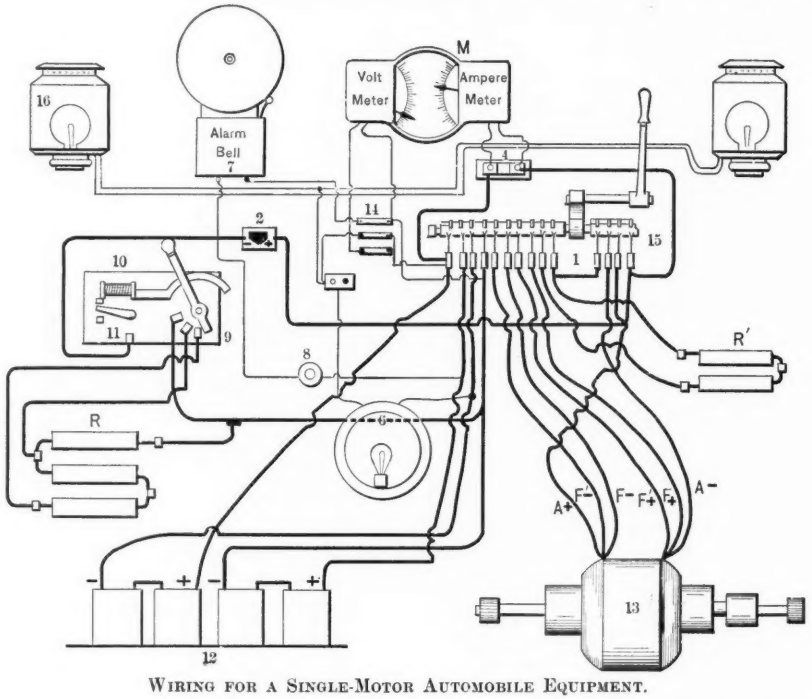
In the diagram herewith is shown the complete wiring of an electric vehicle set up against a wall. So set up and connected the motor can be operated as if in a vehicle. In order to get a better idea of how the connections are made the following key is furnished: In the diagram 1 = controller, 2 = charging plug socket, 4 = ammeter shunt, 5 = press button for lamps, 6 = headlight, 7 = alarm bell, 8 = light switch, 9 = rheostat, 10 = magnet, 11=automatic cutout and switch, 12 = batteries, 13 = motor, 14 = fuse, 15 = reversing device, 16 = side lamps, R = resistance boxes, M = voltammeter, + = positive wires, — = negative wires, A + = armature positive, A — = armature negative, F — = field negative, F + = field positive, F′ — = field negative, F′ + = positive.

The speeds forward and reverse in a vehicle wired as shown are obtained through the controller. This controller, operated by a ratchet, is cylindrical in form and has all the connections made on the surface of the cylinder at the base of the teeth, which, as the controller is pushed around, mesh in the jaws shown in the drawing No. 4.

The sketch should show the reversing key which turns the cylinder, No. 15, so as to bring two sets of teeth up into the four pairs of jaws ready to receive them. All the connections are, in this case, also made on the cylinder as above described. The very favorable point of this controller is that the reverse key, when extracted from its sockets, acts as a safety device because none of the teeth being in the jaws there is no connection. The reversing key pressed downward gives the forward motion, and pushed upward gives the rear.

The wiring, as it stands, is all ready for charging with the one exception that the rheostat should be turned until on the No. 9 third notch instead of being on the first. After the connections have been arranged between the charging plug and the feed wires on the wall, the plug is inserted in its receptacle, No. 2. The current goes out, of course, along the wire marked +, making contact with the first jaw of the reversing device, No. 15; thence out on the wire going from this same connection to the ammeter shunt, No. 4; thence to the last connection of the controller, No. 1. On this controller, when the power handle is in the *vls t* position, there are but two connections between the jaws and the teeth on the cylinder; *viz.*, between the eighth and ninth pair. From the last connection on the controller the current goes down the + wire to the left-hand tray of batteries through the battery connections to the — wire and back to the eighth controller connection; thence through the connection down the + wire to the right-hand tray of cells, through their connections to the — wire and back to seventh connection of the controller. Going out on this connection, contact is made with the third section of the rheostat, No. 9, through the same to the magnet, No. 10, which draws the automatic switch, No. 11, into place when charging; thence through the switch to the — wire of the charging plug in its receptacle.

The automatic switch, No. 11, is not meant to prevent the overcharging of the batteries, but is used to keep any back flow from the batteries running into the feed wire when the voltage has dropped temporarily for any reason. It thus obviates short-circuiting of the cells from this cause.



Wiring for a Single-Motor Automobile Equipment.

The connections for the alarm bell and lights can be more easily traced out than described, except that for the sake of convenience the connections have in some cases been with one tray of cells and in others with the two. These connections vary with the make of the vehicle.

As can be seen, the armature positive and negative wires go to the reversing device, and the four field connections go to the third, fourth, fifth and sixth controller points. The speed variations are obtained by the combinations made on the controller and reversing cylinders which bring the different teeth into position as they are pushed around. By these combinations the resistance boxes are brought into use, and the batteries are drawn on

either in series or parallel, the fields of the motor being used to negotiate the high speed. The shunt, No. 4, is used to protect the voltammeter, and the fuse, No. 14, to protect the lights and bell.

All the lights on the vehicle are illuminated by turning switch, No. 5, and the alarm is sounded by the button, No. 8.

The motor, No. 13, is very ingenious. The pinions are on the end of the hollow armature shaft which is split to insert the differential gear which is shown in the casing on the left-hand side of the armature. The commutator and brushes are placed on the right hand of the armature, the pinions on the end of the shaft meshing into the gears rigidly fastened to the rear wheels.

If the drawing above is supposed to be brought forward from the top, and the battery thrown directly to the rear, with the motor placed in the same position under the vehicle between the back wheels, an idea can be gained as to how the apparatus is placed. The motor cradle is swung from the reach of the vehicle, and is protected from rough roads by rubber cushions.

A number of concerns now manufacturing electric vehicles are using practically this construction, though, of course, each has made a few changes of detail.

The plan here shown is for five speeds ahead and reverse while the others, made on the same plan, admit of but three ahead and one reverse. Here every feature of the construction is called into play to get the speeds, while in most of the others the fifth, or highest, speed is not used as it frequently results in a loss of power. No resistance being used the current rushes out, and is used rather wastefully. It is, however, one of the best systems now installed in electric vehicles, as the high speed is there if occasion requires its use, whereas it need not be called upon if the operator wishes to cover the greatest distance on the smallest expenditure of power.

With such a construction the principal brake is applied mechanically. In one make of vehicle it operates on the differential gear, and on another on the inside of the gearing fastened to the driving wheels by means of a band of steel.

Where it is desired to use a single motor equipment it is hardly possible to obtain a more thoroughly practical design, as all the parts are very accessible and easy to repair. The wiring can be rigidly fastened and strung, and when so arranged there is but little danger of a disconnection.

In the accompanying diagram is shown the wiring chart of an electric vehicle equipped with two motors. The connections may be traced out in this diagram in much the same manner as in that showing the single motor apparatus. In contradistinction to that design, it will be noticed that the construction here shown does not employ resistance coils to regulate the speeds, but obtains the proper control through the motor and the connections effected by the movements of the power lever alone, without recourse to any other device.

The lights and bells are operated by drawing on the trays of cells in a manner somewhat similar to that described above in the single motor construction, all the lamp circuits being provided with fuses.

In order to trace out the circuits, follow the positive wire leading out of the charging plug, which is illustrated by the circle shown just back of the battery trays; the outer circle connects with the positive wire. If followed out, all the combinations on the controller can be easily understood.

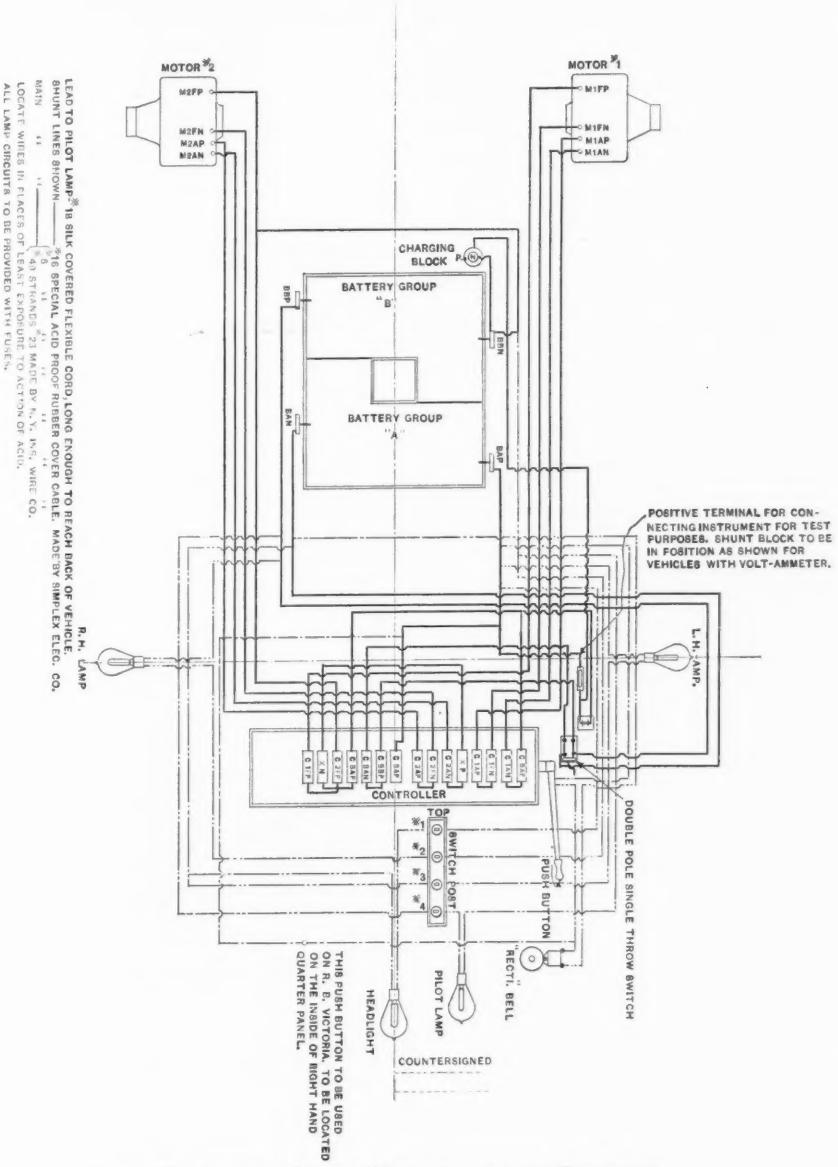
It will be observed that, in this construction, no differential is necessary. The outside wheel turns as fast as need be when not attached to the pivot wheel.

The switching post, shown on the drawing, near the lamps is attached to the lamp circuits.

Directly back and to the left of the controller handle will be seen the place for inserting the carriage key.

All the rest of the apparatus outlined is used in substantially the same manner and in practically the same relation, one part to another, as is described in the specifications of the single motor equipment.

Two motors are usually used upon the heavier varieties of vehicles.


MOTOR #2
M2FP
M2FN
M2AP
M2AN
MOTOR #1
M1FP
M1FN
M1AP
M1AN
CHARGING BLOCK
BATTERY GROUP "B"
BATTERY GROUP "A"
POSITIVE TERMINAL FOR CONNECTING INSTRUMENT FOR TEST PURPOSES. SHUNT BLOCK TO BE IN POSITION AS SHOWN FOR VEHICLES WITH VOLT-AMMETER.
L. H. AMP.
R. H. LAMP
CONTROLLER
TOP
SWITCH POST
PUSH BUTTON
DOUBLE POLE SINGLE THROW SWITCH
RECTL. BELL
PILOT LAMP
HEADLIGHT
THIS PUSH BUTTON TO BE USED ON R. E. VICTORIA. TO BE LOCATED ON THE INSIDE OF RIGHT HAND QUARTER PANEL.
COUNTERSIGNED
LEAD TO PILOT LAMP #18 SILK COVERED FLEXIBLE CORD, LONG ENOUGH TO REACH BACK OF VEHICLE.
SHUNT LINES BROWN
#16 SPECIAL ACID PROOF RUBBER COVER CABLE, MADE BY SIMPLEX ELEC. CO.
#23 (43 STRANDS) MADE BY N. Y. INS. WIRE CO.
LOCATE WIRES IN PLACES OF LEAST EXPOSURE TO ACTION OF ACID.
ALL LAMP CIRCUITS TO BE PROVIDED WITH FUSES.

Wiring for a Double-Motor Automobile Equipment.

The Electric Automobile.

ELECTRIC VEHICLE COMPANY.

One of the pioneers in the field of motor vehicle construction is the Columbia Electric Vehicle Company, which is now known as the Electric Vehicle Company, of Hartford, Ct. Herein are shown some of the latest types of this company's product, which have been used very broadly by those who wish a vehicle which is modern in every particular. The company manu-

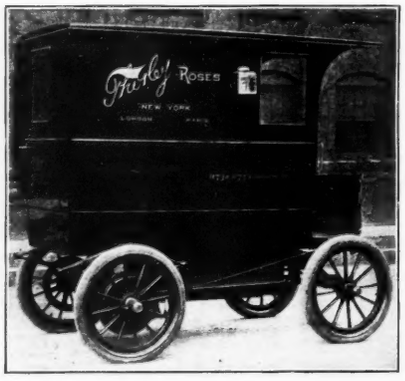
ELECTRIC VEHICLE COMPANY'S PARK VEHICLE.

factures a very complete line of commercial vehicles for business use, a heavy delivery wagon with a capacity of 1,500 pounds, and a light delivery wagon with a capacity of 750 pounds. Its types of pleasure vehicles comprise a surrey, a mail phaeton, a stanhope and other like designs. One of the best designs built by this company is its brougham.

The company uses both single and double motor construction, reserving the latter for heavier work. The Electric Storage Battery Company, of Philadelphia, provides all the means for carrying power for the Electric Vehicle Company's carriages, and the service has always been very successful. One of the latest achievements of the company is that one of its vehicles has been selected to carry mails between the Pan-American Exposition grounds and the Buffalo Post Office, the vehicle in question being required to make 60 miles a day. Special types of battery are used for this work, the long-distance design being the most in vogue. These cells have a capacity sufficient to drive an ordinary vehicle over a distance of 40 miles on one charge. In short, the vehicles of this company combine strength, durability, lightness, symmetry of design, adequate mileage capacity, and speed.

WOODS - WARING & COMPANY.

Woods-Waring & Company, of Chicago, claim to have solved many of the perplexing problems standing in the way of perfected electric vehicle construction. They use a solid rear axle and one motor, all gearing being encased and made an integral part of the motor, while absolutely protected from dust and water. An automatic controller handle operates all the varying speeds, as well as both the electrical and mechanical brakes, the mechanical brakes being applied directly to the wheels by a very powerful friction device. The electrical brake is an arrangement which operates without friction and by means of which it is claimed that the longest hills can be coasted at a moderate speed without the wear, tear and trouble incident to friction brakes. The narrow front wheel tread enables steering to be accomplished by a combination which makes the vehicle respond instantly to the slightest pressure of the steering lever. This concern claims that the current consumption in its automobiles is 20 per cent less than in other vehicles of the same weight, and 30 per cent less in hill climbing, the motor having been designed with this purpose in view. A distinctive feature in the carriage design is the long wheel base which is provided in order to give more foot room in entering and alighting from the vehicle. The even distribution of weight on the wheels, and the extremely low centre of gravity permit of quick manipulation, with safety and comfortable riding, even on rough roads. Woods-Waring & Company offer to the public a road buggy, a victoria, a stanhope, a brougham, a cab and a very extensive line of commercial vehicles.



ELECTRIC VEHICLE COMPANY'S LIGHT DELIVERY WAGON.

AMERICAN BICYCLE COMPANY.

At Indianapolis are made the efficient and handsome automobiles constructed by the American Bicycle Company. The type is known as the "Waverly." The frame is made of seamless tubing, the front axle being of tubular construction. Its engagement with the frame permits oscillation around a horizontal king-bolt, thus equalizing an uneven road surface. The wheels are ball bearing, and are equipped with standard wood spokes and solid rubber tires. The motor is of the Waverly design and combines many special features and improvements that experience has proven necessary for automobile work. The noticeable absence of noise in the operation of the Waverly vehicles is due to spiral tooth gear which this company employs. One lever is used for starting the vehicle, for regulating the speed and reversing. It is located on the left side of the operator, and permits five speeds forward and three to the rear. The brakes are of the band type, applied to the armature shaft inside the motor casing, and are actuated by a foot lever. A device enables the operator to lock the brake when leaving the carriage standing on an incline. Every vehicle turned out by this company is equipped with electric lamps and electric bells. The carriage bodies are of an exclusive design, made of high-class material, and are of modern type and artistic outline. The finish is claimed to be the best obtainable. The equipment of every vehicle includes all the necessary tools, appliances and instruments necessary for the charging and operation, including a combination volt-ammeter of standard make. The company also manufactures a road wagon, stanhope, brake, combination, delivery wagon, and a dos à dos.

ELECTRIC VEHICLE COMPANY'S HEAVY DELIVERY WAGON.

THE AMERICAN ELECTRIC VEHICLE COMPANY.

A number of years ago a company was incorporated in Chicago, under the name of the American Electric Vehicle Company. After attaining an excellent reputation for the reliability of its product, the com-

pany removed to New York, where it has continued its enviable career and is now delivering vehicles to a large number of satisfied users. This company is making a specialty of delivery wagons and the lighter class of pleasure vehicles, including a very handsome runabout, stanhope,

American Electric Vehicle Company's Stanhope.

dos à dos, and park brake. The single motor construction, hollow armature shaft, is used, almost any battery being inserted at the option of the customer. A very marked difference in the construction of these vehicles from that of others is that the automobiles are made on the general carriage construction plan, and are so designed as to permit any good carriage maker to effect the necessary repairs without returning the vehicle to the factory. Tubular construction has been done away with, as well as wire wheels. Pneumatic tires are used exclusively unless solid tires are ordered. The brakes are of a mechanical type and operate with a band in the gear. Five speeds forward and five in reverse are obtained through one handle, the steering being effected by a direct lever.

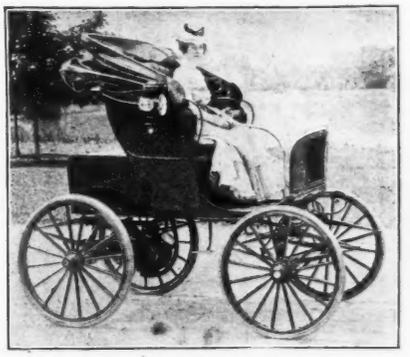
National Electric and Manufacturing Company's Park Trap.

THE NATIONAL ELECTRIC AND MANUFACTURING COMPANY.

At Indianapolis, Ind., the National Electric and Manufacturing Company is turning out its fine line of wagons. This list comprises in its extent a runabout, a stanhope, brake, delivery wagon, and dos à dos. The single motor construction is used, and the frame of the vehicle is made so as to adapt itself to the unevenness of roads. The control is effected through one lever, five speeds forward and three reverse being so given. Wooden wheels with solid tires are applied to every vehicle, unless pneumatics are ordered, when wire wheels are attached. This company uses the Willard battery, and the efficiency of the motor used is attested by its very small consumption of current. Every carriage is fitted with a voltammeter, electric lights, electric bells, and powerful brakes.

THE E. C. STERNS COMPANY.

The E. C. Sterns Company, of Syracuse, N. Y., is manufacturing an electric runabout of the stanhope type which is unique. The side bearings are rigidly attached to the rear axle sleeve by forged steel thorough braces, and to the front axle by fore-and-aft quarter-springs held in place by clips of medium length. The side bars are secured to a front crossbar with a half-spring attached to the front axle by goose-necks and links. This form of construction affords great elasticity in accommodating the wheels to the roadbed. Wire wheels, with three-inch pneumatic tires, 32 and 36 inches in diameter, are used. The rear wheels are driven by means of a compensating gear placed upon the rear axle at the right-hand side of the carriage. The vehicle is fitted with a two-and-one-half horse-power series-wound motor. There is also a special form of series-parallel controller with three speed positions of



The Olds Electric Carriage.

five, eight and twelve miles per hour forward and backward, together with a charging position. There is also a powerful brake connected with the motor, all actuated by one lever at the left of the operator.

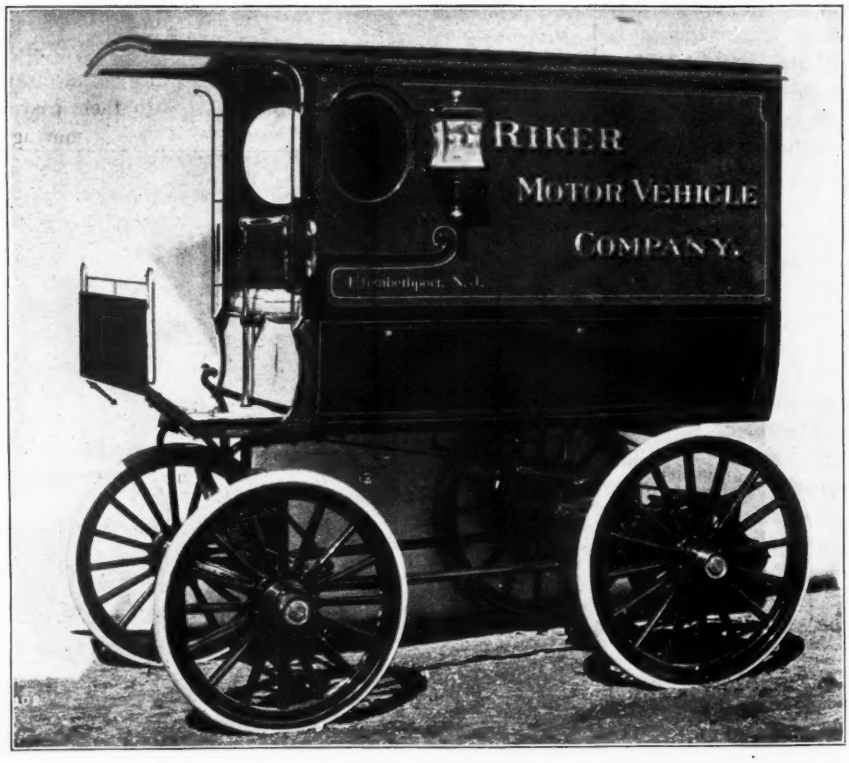
THE OLDS MOTOR WORKS.

The Olds Motor Works, of Detroit, Mich., manufactures electric vehicles. A point particularly claimed by this concern in regard to its type is the excellence of the controller design. It is claimed that the switches in this device are snap-switches in both directions and great care has been used in constructing them to employ the most approved electrical practice. The running switch is a neatly constructed snap-switch, mounted upon slate, its handle being detachable and made in the form of a lock. The gear case is very neat and compact. The reaches consist of tubing, so attached to the motor and pivoted upon the front axle as to form a solid triangular frame. The company also manufactures a switchboard for use in connection with its carriages, especially for charging. Great attention has been paid by this company to the finish of its product, which is claimed to be of superior excellence, and also to the taste displayed in the selection of shapes and designs.

THE RIKER MOTOR VEHICLE COMPANY.

One of the best-known systems employed in the construction of electric vehicles is that patented by Mr. A. L. Riker, and controlled by the company bearing his name at Elizabethport, N. J. One of the better known features of this vehicle is its flexible running gear, which is said to be

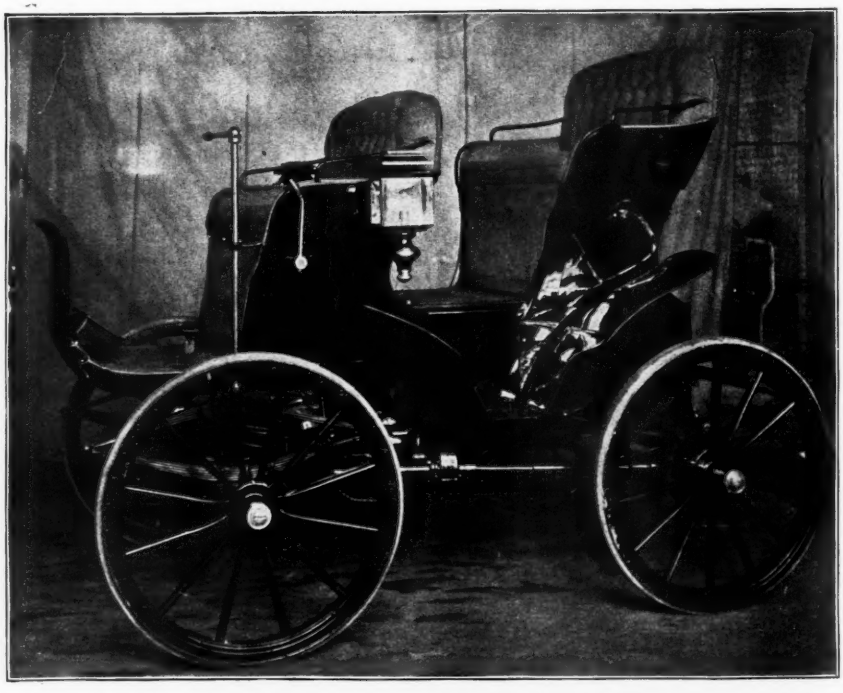
one of the simplest, strongest, and most practical produced. The Riker motor is well known for its efficiency, and the carriage and wagon work on all these vehicles is the result of a long and comprehensive experience. The motions of control in all these vehicles are easy and natural, producing the maximum of efficiency with a minimum of skill in operation. All vehicles are equipped with electric alarm bells, electric side lamps, and combination voltammeters. Over 40 designs are made by this company as standard types. The company has made for itself a great reputation as a builder of special types of wagons, among these being the well-known truck operated by a wine company, and the emergency wagon designed for the Metropolitan Railroad Company, of New York, as well as the large van built for the American Tobacco Company, of the same city.



RIKER MOTOR VEHICLE COMPANY'S ELECTRIC DELIVERY WAGON.

AUTO-DYNAMIC COMPANY.

Up to the present time the great majority of automobiles on the market are constructed so that the motors and machinery are protected from shock by the resiliency of the tires rather than in the body springs. That this principle is not altogether satisfactory has been proven several times in journeys over uneven country roads and wherever unusual difficulties have been encountered in operating the machines. In the electromobile shown in the illustration an entirely different principle has been adopted and it is believed by the manufacturer to be an important improvement over the old designs, inasmuch as the resiliency is entirely in the springs, the wheels being solidly tired and rigidly spoked. Several features of interest distinguish this machine from the others, according to the company's statements, and particular attention is called to the tires, the nature of the controller, the battery and a peculiar locking device. Beginning with the battery, the Auto-Dynamic Company, of New York, which manufactures the vehicle, has embodied in it a principle of grid-construction which it claims to be new, thus increasing the capacity of the battery and rendering it less likely to the faults usually found in such mechanisms. As the patents on the grid and battery are not yet entirely covered it is impossible to go into their details. The controller placed at the left side of the vehicle differs from the controllers on other vehicles, in that it has a swiveled handle-bar. When the power is off the controller stands in the middle of its circuit; when the machine is to be propelled forward the controller is simply moved ahead. From the full-speed position it may be brought back to "off," but before the power can be reversed the swiveled handle must describe an arc of 180 degrees. This prevents any tendency on the part of a green operator to burn out his motor by throwing the reversing lever on when his machine is still going ahead with a heavy load or labors under other disadvantage. In the front of the carriage, close to the driver's foot, a little spur sticks out from under the seat. This is the locking device and the machine can not be put into operation until the key is fastened to the spur and turned down. The tires are a composition of rubber and fibre, so constituted as to weigh less than



AUTO-DYNAMIC COMPANY'S ELECTRIC ROAD SURREY.

a solid rubber tire and are claimed by the company to be much less expensive, to last longer and to be much more serviceable over any sort of road, but particularly on wet or slippery asphalt.

HEWITT-LINDSTROM MOTOR COMPANY.

At Chicago, Ill., the Hewitt-Lindstrom Motor Company is making an electric vehicle of an especially artistic design. Each vehicle is equipped with two multipolar motors of high efficiency and ample power. The controller is of a new and improved type, and is especially designed to prevent heating at the contacts. The perches of the vehicles are flexible, permitting the wheels to adapt themselves to inequalities of the road. All the carriages are provided with brakes on the motors, which are entirely enclosed in the motor casing, and are said to be effective. Wooden wheels and solid rubber tires are put on these carriages, anti-friction devices being used wherever available. The noteworthy features claimed by the Hewitt-Lindstrom company for its vehicles are accumulators and motors of high efficiency, perfect motor suspension, flexible perches, good workmanship, simplicity of construction, small number of parts and automatic safety devices to prevent injury to motors or accumulators. The types manufactured are runabouts, stanhopes, surreys and omnibuses.

THE BAKER MOTOR VEHICLE COMPANY.

The Baker Motor Vehicle Company, of Cleveland, Ohio, is confining its attention at present to one style of vehicle—an electric runabout. The company believes that by doing this and concentrating its attention upon a single class of output, the results generally are more valuable to the purchaser. In these vehicles the running gear is made of tubing, pinned and brazed together, the wheels being of the wire-spoke and pneumatic-tire type. All of the bearings are of the ball type. Only 10 cells of battery are used, these being carried under the seat. The motor has been designed especially for this work and has self-aligning ball bearings. The body of the vehicle is of the "piano-box" type, with sufficient room for two persons and extra room in the rear for packages. The brake interacts with the controlling lever, and, in addition, a powerful friction brake is arranged to be applied to the rear wheels by pressure of the foot in case of emergency. The controller is provided with two speeds and the carriage is fitted up with electric lights, volt and amperemeters and other auxiliaries of high class. It is claimed that the vehicle will average 20 miles on one charge on level macadam roads and will run six and twelve miles per hour. It weighs, complete, 550 pounds.

THE WOODS MOTOR VEHICLE COMPANY.

The Woods Motor Vehicle Company, of Chicago, has been for some time known as one of the most enterprising manufacturers of electrical vehicles. It has been this company's practice from the beginning to avoid falling into settled ruts of construction, and to produce its vehicles in a considerable number of forms, so that all tastes and requirements might easily be met. Taking the principles that have already been well established in this art, the company proceeded in the development of its various styles rather as engineer than as inventor and has turned out a product which it believes to have reached a high degree of engineering perfection. The use of wire wheels and pneumatic tires, as well as that of tubular construction, has been abandoned, and carriage parts have been used which are capable of repair in the ordinary carriage shop. This consideration is one of no little importance to the users of automobiles in districts remote from the manufacturer's shops. The electrical parts have been standardized and simplified with reference also to their easy repair or replacement, while the moving parts are all provided with ball bearings made on the interchangeable system and thus easily replaceable. The vehicles have three and four speeds, which are handled by the same lever that applies the brake. The brake interacts with the controller so that it is impossible to apply the brakes and the power at the same time. It is claimed by the Woods company that the weight of the batteries used by it in these designs has already been reduced to about one-half of the original weight and bulk of such batteries.

TRIUMPH MOTOR VEHICLE COMPANY.

At Chicago, Ill., the Triumph Motor Vehicle Company, offices in the Monadnock Block, is meeting with much success with its automobiles propelled by electricity, steam and gasoline. Its line of vehicles, so far as types go, is very complete, and perfect mechanical construction, as well as substantiability of material, is claimed by the makers.

UNITED POWER VEHICLE COMPANY.

The United Power Vehicle Company, of New York, is making an extensive line of vehicles, electric, steam and gasoline. Its list of carriages comprises types of stanhopes, dos à dos, delivery wagons, heavy trucks, and surreys. The company makes a specialty of manufacturing vehicles of original design, suitable for different classes of work.

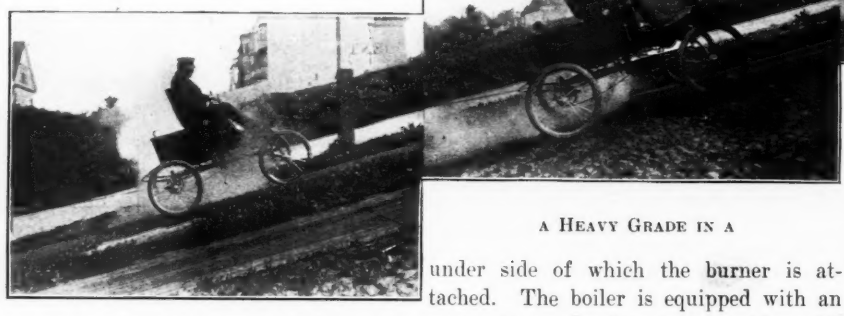
The Steam Automobile.

THE LOCOMOBILE COMPANY OF AMERICA.

The Locomobile Company of America has its main office in New York city and its principal factory at Bridgeport, Ct. The method of operation of the locomobile is extremely simple. Steam is generated in an upright copper boiler containing 44 square feet of heating surface. The heat applied is procured by burning the vapor of ordinary gasoline. Water is supplied to the boiler by a direct-action pump connected to one of the cross heads of the engine. A by-pass lever gives entire control of the water supply to the boiler and steam pressure is registered on a gauge placed at the right-hand side of the carriage body, where also is shown the height of water in the boiler. These vehicles are fitted with a "pop" relief safety valve, which opens at 240 pounds pressure. The boiler is tested to 600 pounds cold-water pressure, and is claimed to be unexplodable under all conditions. The engines are of the standard locomobile type. The reverse gear is a simple link motion, and with the exception of the eccentric all bearings are ball bearing. The wheels are lubricated by a self-feeding oil cup. The exhaust steam is muffled, and makes practically no noise. The running gear is mounted on four pneumatic-tired wheels, so gauged that the vehicle will track in country roads. The side steering lever is steady, and obviates any vibration to the hand while traveling over rough roads. The fuel tank and the air tank are made of strong heavy copper tubing, and will stand over 100 pounds of pressure. A check valve prevents any gasoline from getting into the air tank. Water is carried in a copper tank divided into compartments, so that the water can not splash about while the vehicle is in motion. An auxiliary hand pump is placed in a convenient position near the

seat in order to assure the proper supply of water being at hand for the boiler. Every vehicle of this make is equipped with a water column, having three gauge cocks. Each carriage is supplied with a simple but powerful friction brake, the lever being conveniently placed near the right foot. The fire is controlled by an automatic valve which lowers the steam when the pressure reaches 180 pounds. The speed is varied by the throttle lever alone, there being no speed-changing gears or devices, and the vehicle can be run at any rate from one to forty miles per hour.

An example of the ability of the "Locomobile" to take care of itself under adverse circumstances is well illustrated by the engraving on this page, showing one of the machines climbing a hill that seems almost insurmountable. The brakes on



A "Locomobile" Climbing A Heavy Grade in a

the machine are sufficiently powerful to allow it to descend such a hill with entire safety.

AMERICAN BICYCLE COMPANY.

The American Bicycle Company, whose automobile department is located in New York city, has introduced as its steam vehicle what is known as the "Toledo" steam carriage. This is a handsome vehicle, having a body of the stanhope type with aluminum dashboard and panels. Wire wheels with pneumatic tires are used and a special steering device for which particular advantages are claimed. The boiler is of the water-tube style and is tested to 800 pounds cold pressure before installation. The fire is controlled by a neatly devised automatic regulator, operated by steam pressure from the boiler. A pilot light is provided to act in case the main burner goes out. The engine is of six and one-quarter horsepower, double acting, and has piston valves; two sprockets and chains connect the driving shaft to the dust-protected compensating gear. The engine being encased is also dustproof. Control and reversal of the engine are accomplished by a single lever. The water tanks hold 35 gallons and the gasoline tank nine gallons. While the engine contains nothing new, it is claimed by its makers to be highly perfected in point of workmanship and finish.

EMPIRE MANUFACTURING COMPANY.

Steam vehicles that have points of difference from others in the market are being built by the Empire Manufacturing Company, of Sterling, Ill. The principal points of individuality are in the use of a transverse rectangular water-tube boiler, a double-cylinder steam engine, in which the two cylinders are placed at right angles to each other, a direct spur-drive and a complete steel framework. There is a jacket that goes around the boiler, to the under side of which the burner is attached. The boiler is equipped with an economizer and a live-steam purifier. Its tubes are cold-drawn seamless steel, and are claimed by the manufacturers to be superior to copper tubes for durability and strength. The boiler is equipped with a steam gauge safety valve and is tested to a pressure of 400 pounds to the square inch.

STEAM VEHICLE COMPANY.

A concern which holds a high place among those who manufacture steam vehicles is the Steam Vehicle Company, with offices at 253 Broadway, New York city. One of the special points of advantage claimed by the manufacturers for this vehicle is the engine, which is of a radically different type from that used in most steam vehicles. The boiler is another point of excellence, the company claiming that it is almost impossible to burn it out. These points will recommend themselves to those who have used steam vehicles, and the success which the company is meeting from the public is evidence of the excellence of its product.

GROUT BROTHERS.

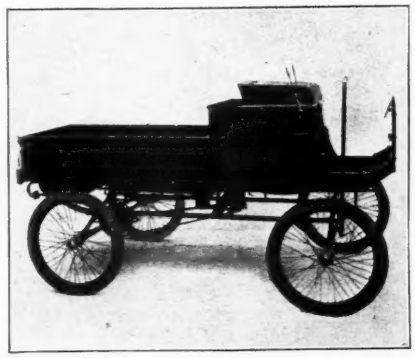
A concern which has had distinctive success in placing its product before the public is that of Messrs. Grout Brothers, of Orange, Mass. This firm is filling a large number of orders for its product. The vehicles are heavier than the usual type of steam carriages, of considerably greater width, and have a longer base. The engine is well made, of considerable weight and is thoroughly and scientifically put together. Its parts are interchangeable, and the carriage seems to have given much satisfaction.

MILWAUKEE AUTOMOBILE COMPANY.

One of the best-known American steam carriages is that made by the Milwaukee Automobile Company, at Milwaukee, Wis.

San Francisco Street.

The frame connections are drop forgings, pinned and brazed in place, the front and rear trusses being held together by distance tubes. The steering linkage gives the front wheel a movement of 60 degrees. The sprockets of the driving gear are securely fastened to the spider, which also operates the brake, to which a device has been attached that holds the carriage either forward or backward on any grade. The bodies of all vehicles are gracefully



Milwaukee Automobile Company's Express Wagon.

designed, well made, and strongly braced. Every vehicle is furnished with an electric battery to provide power for small lights at the water glass and steam gauge in night service. A chime gong, operated by foot pressure, is also provided. The rubber or leather boot at the rear of the carriage has been discarded, and a light, well-enameled cover has been substituted. The Milwaukee company manufactures runabouts, stanhopes, surreys, delivery wagons and trucks.

PROFESSOR ELIHU THOMSON'S STEAM AUTOMOBILE.

Professor Elihu Thomson, of Lynn, Mass., has been developing a steam automobile for three years. While he has looked forward to the ultimate production of an internal combustion motor us-

PROFESSOR THOMSON'S STEAM CARRIAGE.

ing kerosene oil and burning it completely, he believes there is a wide field for the properly developed steam vehicle. The carriage here illustrated is driven by a flash boiler fired with kerosene oil. The engine is a high-economy, single-acting machine, developed for the purpose, giving, under test, the remarkably low result of 17½ pounds of water consumed per horse-power-hour. The rear axle is driven by means of a worm and worm-wheel enclosed in oil, the differential gear being enclosed with the worm-drive. It is stated that the efficiency of this drive is 86 per cent. In descending hills it acts as a brake and drives the engine so that for ordinary descents it is unnecessary to use the carriage brakes. Considerable work has been done in developing automatic control of steam production. Of course, no steam pressure gauge or water level gauge is necessary. Owing to the low steam consumption and the use of superheated steam the carriage, though quite heavy, shows but little condensation of vapor while underway, and, in fact, exhibits no steam unless the atmosphere is saturated with dampness. Mr. Herman Lemp, who has been working with Professor Thomson on these machines, has also brought out an interesting type of carriage driven by three-cylinder engines, each engine driving its individual rear wheel through a sprocket chain, thus avoiding the necessity for a differential gear.

THE KIDDER MOTOR VEHICLE COMPANY.

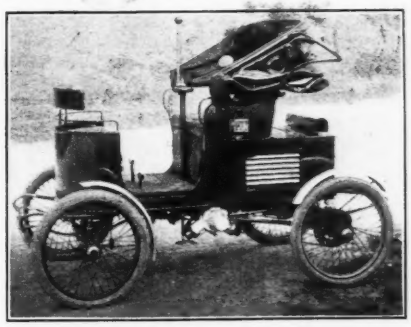
At New Haven, Ct., the Kidder Motor Vehicle Company is turning out a very handsome line of carriages, comprising runabouts, stanhopes, surreys and delivery wagons. The motive power is steam and the vehicles are meeting with a great deal of success. The design of the delivery wagon is especially noticeable because of its difference from the ordinary type.

THE MOBILE COMPANY OF AMERICA.

Mr. John Brisben Walker, editor of the *Cosmopolitan* magazine, is president of the automobile company manufacturing steam vehicles at Tarrytown, N. Y. This concern, the Mobile Company of America, is possessed of an extensive plant and is making specialties of its runabouts, surreys, stanhopes and delivery wagons.

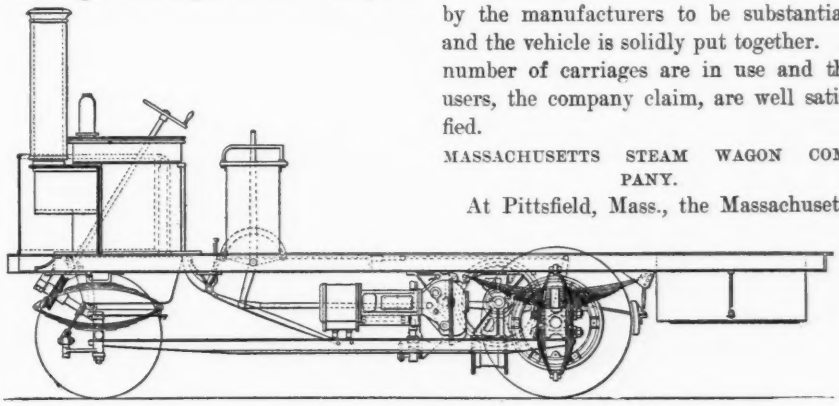
COOK LOCOMOTIVE AND MACHINE COMPANY.

At Paterson, N. J., the Cook Locomotive and Machine Company is building several types of heavy vehicles made under the (British) Thornycroft patents. The Thornycroft truck is 17 feet 6 inches long by 6 feet 6 inches in width across



MR. LEMP'S STEAM CARRIAGE.

the platforms. The height of the platform is 3 feet 9½ inches when loaded with 3 tons. The frame is of channel steel, and is supported upon axles by regular bearing springs. The driving axle is made of a heavy forged steel shaft, and affords great strength to the vital parts



ELEVATION OF THORNYCROFT STEAM TRUCK.

of the mechanism. Although required to transmit only 35 horse-power as a maximum, the same size is able to transmit some 120 horse-power. The wheels are made with metal hubs, ash spokes and felloes, and are equipped with broad, steel tires. The front steering wheels are pivoted on the Ackerman system. The boiler is of the water-tube type, annular design, centrally fired from the top with soft coal. It is also so arranged as to permit the connection of the upper annulus with the bottom vessel. The fire is placed in the hollow of the lower annulus in such a manner that the tubes are preserved from contact with the burning coal. Draught is created by the exhaust blast. The engine is suspended from the channel steel under-frame. It is of the horizontal, compound, reversing type, and can be disconnected from the countershaft and run freely without propelling the vehicle, and it may be employed to hoist a load to the platform.

The two types of vehicle which are being turned out by the American holders of the Thornycroft patents have capacities of three and five tons.

CENTURY MOTOR VEHICLE COMPANY.

One of the most distinctive types of automobile is that made by the Century Motor Vehicle Company, of Syracuse, N. Y. This concern is devoting its attention to carriages operated by steam and electricity. The gearing is devoid of chains, and the carriage is propelled by a shaft which runs from the engine to the differential. The same construction is in use in the electric vehicle as in the steam, a motor being applied instead of the engine.

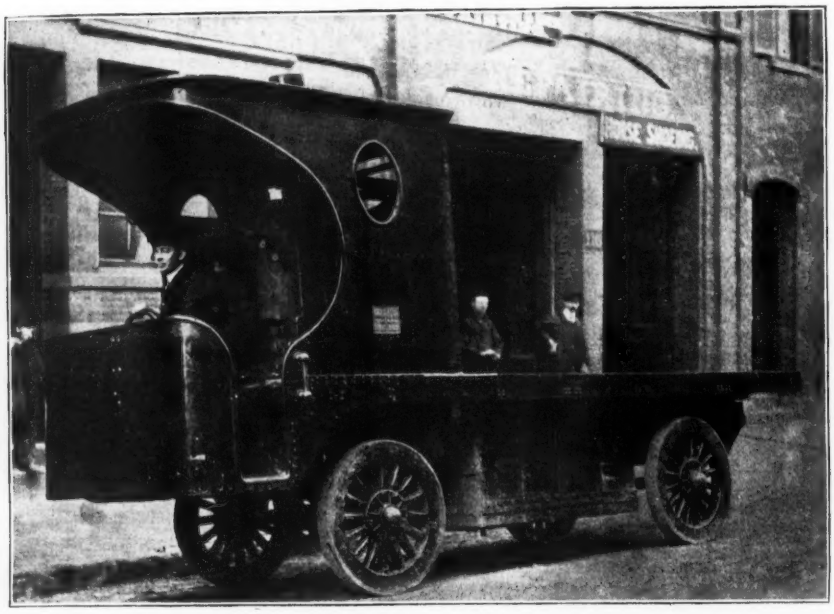
THE STANLEY BROTHERS.

The Stanley Brothers, Boston, Mass., are manufacturing a handsome steam vehicle which is similar to the well-known and popular runabout type of vehicle operated by that power. The finish is said to be excellent, the construction is claimed by the manufacturers to be substantial, and the vehicle is solidly put together. A number of carriages are in use and the users, the company claim, are well satisfied.

MASSACHUSETTS STEAM WAGON COMPANY.

At Pittsfield, Mass., the Massachusetts Steam Wagon Company is manufacturing the truck shown in the accompanying illustration. Its capacity is three and one-half tons burden, and its speed five miles per hour. The wheels are made with metal hubs, wood spokes and rims, the

diameter being 34 inches. Steel tires, three and three-quarter inches wide and one inch thick, are used. All four springs of the vehicle are of the slim-elliptical type held rigidly at the front ends, but movable at the rear to allow for compression. Steering is effected by the fifth-wheel method, through a series of spur gearing and a worm, a hand wheel being placed in the cab within easy reach of the operator. The frame is built of standard rolled sections and is suitably braced to make it rigid. The engine is a compound horizontal, and is rigidly attached to the frame by means of a web-plate. It consists of a pair of three and one-half by six by five-inch cylinders of the locomotive type. Means are provided by a special valve to admit steam to all cylinders by means of which 50 horse-power can be had for a short time. Power is transmitted from the engine shaft by a spur gear to two countershafts carrying two "Cunningham" hydraulic clutches, one forward and one back of the engine shaft, all lying in the same plane. Keyed to the countershafts are sprocket wheels from which power is transmitted to the differentials of both front and rear axles. These chains are kept taut by means of stretcher rods and tightening springs, shocks on the engine being thus avoided. The front differential has in combination with it a specially devised gimbal joint, which permits of the axle being turned without interfering with the transmission of power. The front set of wheels may be used alone to run the vehicle, or both the front and rear cylinders can be used, or the engine may be run free. All this is controlled by two small valves in the cab and within handy reach of the driver. Two casings with friction surfaces comprise the brake. They surround and act on the outside surface of the hydraulic clutches. The boiler is of the upright fire-tube type, and is fired from the front. It is placed in the rear of the operator and in such a position that its weight is directly over the front driving wheels. Either coal or coke may be used for fuel, and the necessary draft for the fire is obtained by the forced draft method, air being supplied by a fan blower driven by a small vertical engine. An independent pump supplies water to the boiler. The vehicle is equipped with a feed-water heater, which also acts as a muffler to the steam which passes into the stack and then out in an invisible state. The water tank is situated at the rear end of the frame and will hold 900 pounds of water, the fuel bunker holding about 300 pounds of coal.



Massachusetts Steam Wagon Company's Truck.

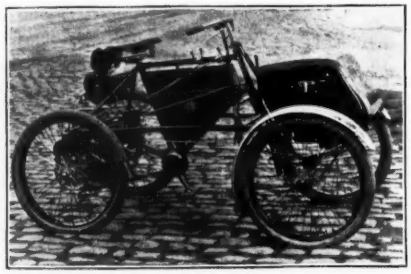
VICTOR AUTOMOBILE COMPANY.

At Chicopee Falls, Mass., the Victor Automobile Company is turning out a very handsome and substantial steam carriage which received much commendation at the Automobile Show held in November at the Madison Square Garden. Mr. Overman, the president of the company, claims for his product simplicity in management, perfection in construction, and beauty as to design and finish.

The Gasoline Automobile.

THE DE DION-BOUTON "MOTORETTE" COMPANY.

A successful vehicle is being manufactured in Brooklyn by the company holding the American rights of the De Dion-Bouton patents of France. This company is making a hansom cab which weighs 1,100 pounds, is geared to travel at not more than 16 miles an hour and is intended for city use. The cab has all the latest attachments, with special observance to motor vehicle requirements. The De Dion light delivery wagon weighs 950 pounds, and will carry 750 pounds, exclusive of the weight of the operator. In the recent delivery-van trials, held in Paris, the De Dion made a very excellent showing, doing its work with great regularity and speed. The vehicle is fitted with the new 1901 five-horse-power De Dion motor. Its wheels are 30 inches in diameter and tires 3½ inches. The vehicle is especially fitted for delivery purposes, such as those of florists, hatters, dry-goods dealers, laundries, etc. One of the very distinctive types of vehicle manufactured by this company is the doctor's motorette, fitted with a glass front and connecting apron. This vehicle is also of five horse-power and is geared to 25 miles an hour. The glass front is easily removable and forms a useful addition at all times, especially for travel after dark or in a strong wind. The quadricycle illustrated here possesses many new features in the 1901 model. The vehicle was built in France, has been in this country for only a short time and represents the very latest French features in this connection. First comes the free clutch feature, which is of great value. The application of this device permits the driver to start his motor without being required to move the whole vehicle, which was always an unpleasant feature of former models. When the motor gets up speed the clutch is thrown into engagement, thus starting the vehicle. Other features of the 1901 quadricycle comprises a new vaporizer of design similar to that applied to the new model motorettes. Another leading feature is the increase of its motive power to two and three-quarters horse-power, instead of the former two and one-quarter-horse-



De Dion Quadricycle.

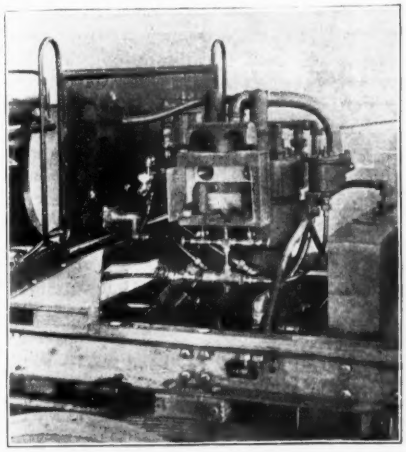
power, water-cooled motor. This additional power assists the vehicle in negotiating hills, and on the level higher speeds are possible. A small radiating

De Dion-Bouton Delivery Wagon.

coil is situated beneath the water tank just below the saddle. A gallon and a half of water suffices to cool the motor and the advantage of the more powerful engine is at once apparent.

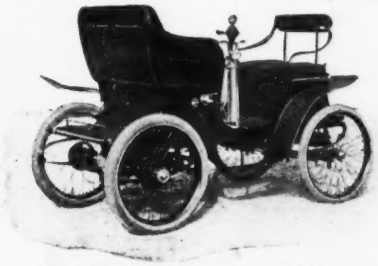
THE DAIMLER MANUFACTURING COMPANY.

The Daimler Manufacturing Company, of Long Island City, N. Y., was one of the pioneers in the construction of automobile vehicles in the United States, and restricts its product to gasoline vehicles. The carriage here illustrated is a delivery wagon, carrying loads up to 1,500 pounds,



Daimler Manufacturing Company's Motor.

weighing empty, with fuel and water, approximately 3,000 pounds. The main frame is isolated in an ingenious way from the vibration of the engine. Wood spoke wheels are used, with solid rubber tires. The motor is of the twin-cylinder, vertical type and develops six horse-power. The crank runs in a casing partly filled with oil and the motor is provided with an inertia governor for speed regulation. By the use of a lever, known as an accelerator, the motor speed may be increased from the normal 750 to 900 revolutions per minute. Hot-tube ignition has been employed in the past, but electric ignition will be used in future. A rotating magneto generator will be used with a make-and-break igniter. The gasoline tank is sufficient in capacity for a run of 150 miles. The flywheel on the engine shaft forms one of the members of a conical friction clutch normally held in engagement by a spring. The change-gear system consists of two parallel shafts, one above the other, each provided with four cut-steel spur gears. Speeds of four, six and one-half, nine and twelve miles an hour may be obtained by chang-



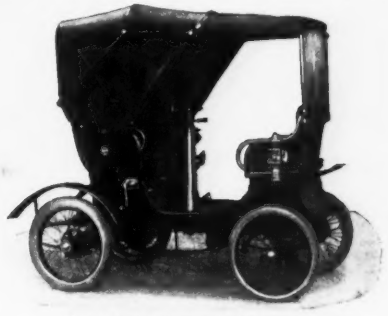
De Dion-Bouton Company's Vehicle.

ing the engagement of these gears. The levers for accomplishing this are made inter-locking, so as to avoid simultaneous engagement of two sets of gears. The brake works on a drum on the counter gear shaft and all the gears, including the differentials, are enclosed in metallic casings and run in oil. Chains are used to transmit driving power to the wheels. Very ingenious cooling devices are employed. Steering is by means of a hand-wheel on the vertical shaft. The other details of the vehicle resemble those of ordinary practice.

Olds Motor Works Gasoline Runabout.

REMINGTON AUTOMOBILE AND MOTOR COMPANY.

At Ilion, N. Y., the Remington Automobile and Motor Company is manufacturing hydrocarbon cars which are claimed to have many points of superiority over other vehicles of similar design. The motors in these carriages are constructed with a view to economy in coal, simplicity in operation, durability in service, and without an attempt at extra frills or reduction of the weight to the detriment of the motor as a source of power. The interior or working parts are all carefully constructed in the most complete manner. Not a single motor is permitted to leave the Remington factory until it has run a sufficient time on the blocks in the shop to demonstrate its construction. These engines are two-cylinder in design and four-cycle in operation. The crank pins are set parallel to the main shaft, the valves being operated by cams on a shaft running across the head of the motors by means of a chain or gears driven from the main shaft. The four-horse-power

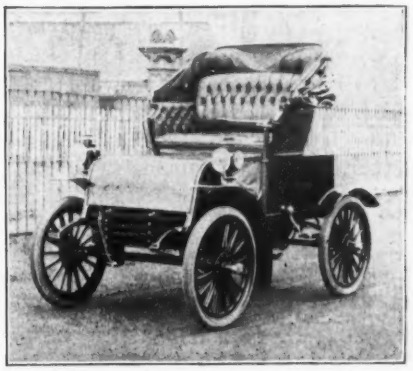


De Dion-Bouton Vehicle.

motor has its cylinders and crank case cast in one piece, the cylinders being water-jacketed. Its head is a separate casting containing all the bolts, cams, cam-shafts, igniters, etc. The vehicles are equipped with either a jump-spark, wipe-spark or make-and-break form of ignition. To each of the motors is attached a Remington carbureter, vaporizer and muffler.

THE AUTOMOBILE COMPANY OF AMERICA.

The Automobile Company of America has its factory at Marion, N. J., and devotes its attention to the construction of gasoline automobiles, known under the



Automobile Company of America's Latest Gasoline Vehicle.

title of "gasmobiles." This company constructs a large number of standard models, mostly two and four-passenger vehicles, fitted to withstand the rough and ready use of country roads. The mo-

tor is of a triple-cylinder design, which is claimed practically to suppress all vibration. European practice has been followed in abolishing the connection between front and rear actions, and great flexibility has thus been obtained. Large diameter wooden wheels are recommended, and this company makes all parts of its own carriages except springs and tires.

WINTON MOTOR CARRIAGE COMPANY.

The Winton Motor Carriage Company, Cleveland, Ohio, makes a vehicle, the motive power of which is a gasoline engine. The 1901 type is considerably heavier as regards power than that of last year, and is enough stronger to justify gearing to much higher speed than before. Wheel steering has been installed, and for a matter of general convenience this concern equips the four running wheels with the same size rims and tires. The driving gears are now encased and are run in oil and thus the manufacturers claim absolute protection from dust and dirt. The gasoline storage capacity has been increased to eight gallons, the makers stating that they are thus assured of a supply of fuel for a continuous operation over 150 miles of average roads. Direct gearing to the improved differential is claimed to do away with much friction. No countershaft is used in the new vehicles, and the lessened number of gears decreases the noise in operation. The remaining gears being encased and running in oil greatly reduce the noise of operation. A great improvement in the sparking device is claimed. The general adjustment is positive in effect, and once set there is little likelihood for slipping one way or the other. Circulation of water for cooling the jacketed single cylinder is aided by a small rotary pump of simple construction. A reliable brake has been added to the equipment, this being considered by the manufacturers as a noteworthy feature of their product. All the running gears are built the usual road width or gauge.

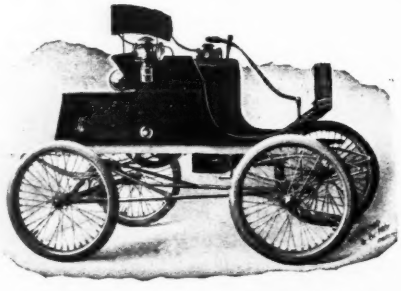
THE HAYNES-APPERSON COMPANY.

At Kokomo, Ind., is the factory of a pioneer company in the American field of gasoline vehicle construction. The Haynes-Apperson Company has long been known in the United States as a manufacturer of high-grade gasoline vehicles. Its product received much commendation at the shows held during the last five or six years, and has been largely used throughout the country.

VEHICLES OF THE AUTOMOBILE CLUB OF AMERICA PHOTOGRAPHED AT THE DE DION-BOUTON COMPANY'S FACTORY.

THE AUTOCAR COMPANY.

At Ardmore, Pa., the Autocar Company is making a gasoline vehicle, fitted with a balanced motor which runs with little vibration. Its mileage capacity of gasoline and water is about 75 miles. The manufacturers claim that the vehicle will climb any grade up to 35 per cent, the highest speed on a level being 25 miles an hour. All the parts, with the exception of the bodies and tires, are made in the Ardmore company's own factory, and the vehicles are claimed to be as nearly perfect as possible in workmanship, material and design.



THE AUTOCAR COMPANY'S RUNABOUT.

FOSTER AUTOMOBILE COMPANY.

At Rochester, N. Y., the Foster Automobile Company is turning out a vehicle for which it claims important advantages. An extensive list of designs is manufactured by the Foster company, and its carriages are said to be easy to manage, under absolute control, and strong in their mechanical parts.

AMERICAN BICYCLE COMPANY.

The American Bicycle Company's automobile department constructs as its type of gasoline vehicle the "hydro-car." This quite popular vehicle is controlled by advance or retard of the igniting spark, and it is claimed that within a few seconds the speed of the motor may be changed from 100 to 1,100 revolutions per minute. The engine is of the double-cylinder vertical type, of four horse-power. The fuel used is ordinary stove gasoline.

The bearings are encased and run in oil. The carbureter is claimed to be particularly perfect, as is also the transmission gear. It is said that the hill climbing gear will take the heaviest grades met with in road work. Cooling is obtained by a water jacket on the cylinders, the water being conveyed by a small pump solidly coupled with the engine. Two powerful brakes are furnished with each vehicle.

The design of the carriage body is such as to give room for supplies and surplus clothing, while the back of the seat is high, affording great comfort to the rider.

SEARCHMONT MOTOR COMPANY.

A vehicle which attracted a great deal of attention at some of the automobile shows held recently is the wagonette made by the Searchmont Motor Company, of Philadelphia. The body of the vehicle is placed very low, and is thus rendered easy of access. Wire wheels are used, and are equipped with pneumatic tires. Either five or ten-horse-power engines are used. A special feature of this type of vehicle is that the parts are made on the interchangeable plan and are also readily accessible. All the wheels are 32 inches in diameter, and it is thus necessary to carry but one size of spare tire. The 10-horse-power motor has two cylinders, vertically arranged, the cranks being lubricated with running oil. Ordinary stove gasoline is used for fuel, the tank capacity being five gallons, which carries the vehicle 100 miles over ordinary roads.

WALTHAM MANUFACTURING COMPANY.

At Waltham, Mass., the Waltham Manufacturing Company is turning out a large line of motor vehicles of all types operated by gas engines. The company claims much for its vehicles and is meeting with success.

European Automobiles.

The European automobile field is extremely extensive, and even though in this country much wealth is invested in the development of the motor vehicle, we do not approach the number of persons employed in the construction of automobiles on the other side. In England a great deal has been done in the way of developing the gasoline vehicle. To a great extent the English manufacturers and designers have been influenced by French ideas.

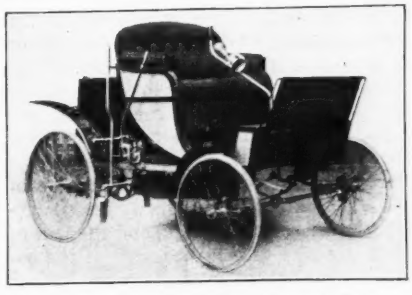
COULTHARD & COMPANY'S STEAM TRUCK.

The Motor Manufacturing Company, Limited, makes a miniature Panhard, which is equipped with a five-horse-power water-cooled motor. It has electrical ignition, the Panhard system of gearing, three speeds, reversing gear wheel, steering roller chains and ball bearings. This company is located at 147 Holborn Viaduct, London.

The Motor Car Company, of 168 Shaftesbury avenue, London, W. C., is handling the Decuaville voiturette. One of the principal points of superiority claimed for this vehicle is that the motor is started while the driver is actually seated in the car. The vehicle is equipped with a five-horse-power water-cooled motor and holds the record for the non-stop test of 1,000 miles in two days.

The Sterling Motor Carriage Company, Limited, of Glasgow, is making seven and five-horse-power vioturettes in the type of a road buggy with a rumble, and a dos à dos. The road buggy is fitted with a seven-horse-power four-cylinder motor, and weighs 1,050 pounds. It speeds to 25 miles an hour or over, is claimed to be silent, and moves with little vibration. The lighter vehicle is fitted with a five-horse-power DeDion water-cooled motor, weighs four and a half hundred weight, and speeds to 18 miles an hour or over.

The International Motor Car Company is turning out very handsome vehicles, which the builders claim to be English in every detail. They are said to be good hill climbers and have no gear or pumps, and they further claim that there is no necessity for leaving the carriage in a run of 100 miles or more.



ROOTS AND VENABLES (ENGLISH) CAR.

E. W. Hart, Luton Beds, is offering the Sirene voiturette. Among its virtues are that it uses no chains, no belts, is very speedy and consumes but a small amount of fuel.

The Orient Express Car Syndicate makes a very handsome heavy vehicle, which is equipped with a six-horse-power engine, magneto ignition, an automatic carbureter, has three speeds forward and reverse, and is equipped with powerful brakes.

The Star Motor Company, of Wolverhampton, is turning out vehicles which are said to be good hill climbers, and are certainly smart in appearance.

Messrs. Roots and Venables, whose vehicle is here illustrated, have had much success with their carriage, which has the distinction of being one of the few automobiles equipped with a gas engine running on kerosene oil.

The Sports Motor Company is another distinctively English concern and is located in London.

The Yorkshire Motor Car Company, Limited, makes a specialty of the Mytholm doctor's car, which is equipped with a five-horse-power single-cylinder motor, a live axle, a central drive, one belt and one chain. It carries two passengers and seems to be a well made carriage.

T. Coulthard & Company, of Preston, whose truck is here illustrated, have had much success in the heavy truck line of work.

The Thornycroft Steam Wagon Company, Limited, of Chiswick, whose vehicle is also illustrated in connection with the American company, has been eminently successful with its heavy truck. It is said to contain some of the best ideas yet developed for such construction.

The great English car is the racing Napier, which has taken many prizes and won many tests. These cars, as well as some of other makes here mentioned, are to be entered in the races on the Continent to be held this Summer.

In France we come to the home of the automobile. In no country has the motor vehicle been developed as it has been in France. Among the leading carriages we may mention the Mors vehicles, the voitures Bardon, the Gardner-Serpollet steam carriages, the Decauville cars, the Rochet automobiles, the Daracq vehicles, and the Koch cars. In all there are over 300 concerns making motor vehicles in Paris and throughout the French Republic. In this connection it is pleasant to note that American vehicles, both electric and steam, have been received with much favor, the steam vehicles because of their light construction and artistic design, and the electric vehicles because of their great elegance and perfection in construction. To such an extent is this so, both in

France and in England, that the American cars are almost as well known to foreigners as those made in their midst.

Austria and Belgium are paying much attention to the development of the automobile, most of the concerns being located in Vienna and Brussels, respectively.

In Denmark the Northern Motor Car Company, at Copenhagen, is turning out carriages of a handsome design. The great German companies devoted to automobiles are the Bens Corporation, of Mannheim, and the Daimler Company, of Cannstadt. De Dietrich & Company, of Elsass, are also receiving much favor. Holland, Italy and Switzerland boast of over 10 automobile manufacturing concerns apiece, all of which are receiving a good deal of substantial support from those living in the respective countries.

The French vehicles, as well as all other foreign makes of machines, have reached their highest point of development in the field of the internal combustion motor. Electric vehicles are also manufactured in great numbers, Paris and London being well supplied with this style of carriage. Considerably more attention has been paid to the heavy commercial vehicle truck, delivery wagon and omnibus than has been paid here. Five or six concerns in England are manufacturing heavy trucks for the market, while in France almost all the companies of any note have turned their attention to this phase of the industry.

HYDROCARBON OR GASOLINE MOTOR VEHICLES.

BY C. J. FIELD.

The hydrocarbon or gasoline motor vehicle is only just commencing its real commercial development in this country, and going to the position where it rightfully belongs, as a general, all around pleasure and touring vehicle, and also for commercial wagons for delivery purposes up to a ton or a ton and a half load.

The gasoline automobile is the product of French and German development, mainly French. In this country we have had prominently before us the electric vehicle and for the last two seasons the light steam carriage. While electricity has its field, it is undoubtedly limited to pleasure carriages for the wealthier class until such time as a suitable substitute is found for the lead oxide storage battery, and while the steam automobile is meeting with more or less public recognition up to this time, its field has been that of light pleasure carriages, to which field it is not as well adapted as is the gasoline vehicle. The field to which the steam carriage will ultimately adapt itself, to the best advantage, will be for heavy commercial use for loads of one and a half and two tons and over. This division leaves by far the larger field as most suitably covered by the gasoline motor vehicle, as it has more points of advantage and less points of disadvantage for the uses above stated than either the steam or electric automobile.

To see the full extent of the development of the gasoline motor vehicle in previous seasons, we have to look to France, where this type of vehicle has reached a state of development far in advance of that in any other country. The gasoline motor vehicle has certain peculiarities, in reference to its development and adaptation, which puts it in a much different position from either steam or electric automobiles. While a man may design and build a good steam or electric machine in reasonable time, it takes years of practical experience and experimenting to produce and turn out a commercially successful gasoline motor vehicle. It is for this reason that we see so many unsuccessful experiments around the country in attempts to produce a commercial vehicle in this class, and so few successful ones on the market.

There are three types of motors in general use for gasoline motor vehicles:

First. The slow-speed or multiple cylinder hot-tube ignition motor, which is well represented by the Panhard, Daimler and Napier, and other makes abroad, and modifications of them in this country. This system is the earliest one to be commercially developed, and is adapted particularly to the heavier class of vehicles. In this motor the exploding of the charge is secured by a hot tube, which is kept to an incandescent heat by an oil lamp.

Second. The second type is the slow-speed motor with the wipe or contact spark ignition. In this type the explosion is caused by a contact point attached to the piston coming in contact at a predetermined time with the other electrode of the electric circuit or by some equivalent arrangement. This type is represented by two or three of the later American types on the market and is also being developed to more or less extent abroad, but it is not as successful a type as the others. The disadvantage of this machine is the necessarily heavy construction of the machinery, and the fact of not being able to vary the time of the explosion, excepting within a very limited range, and, therefore, work the engine to the best advantage.

Third. The third type of gasoline automobiles is that represented by the light motor of the De Dion type, and imitations thereof using the jump spark ignition. This type of vehicle has as its most prominent representatives, the firm of De Dion, Bouton & Company, and has been commercially developed by this firm. The points of advantage of this type of motor are its light weight and its flexibility. It is a vehicle of 800 pounds weight with five effective horse-power, and a carrying capacity of four persons.

Electric Lighting

Press despatches from Rome, Italy, state that the newly installed electric lighting plant in St. Peter's Cathedral was put in operation on Sunday night, April 7, in the presence of 80,000 spectators. The display is said to have been very brilliant and most gratifying.

Mr. J. Pierpont Morgan, the New York financier, has recently purchased the entire plant of the Liberty, N. Y., Electric Light and Power Company, and presented it to the Loomis Sanitarium for consumptives, which is situated two and one-half miles away from the village. Mr. Morgan is said to have paid $40,000 for the plant. He is one of the trustees of the sanitarium.

Reports from Boston, Mass., on the much talked of consolidation of the electric lighting interests in that city state that Messrs. Edgar and Maltby, presidents of the Edison Electric Illuminating Company and the Boston Electric Light Company, respectively, said in recent interviews that "There has been so much guessing as to the terms upon which the Edison and Boston companies will be consolidated that we consider it best to give out the terms officially. You may announce that the terms of exchange will be 10 shares of Edison for 10¾ shares of Boston."

Wall Street and the Electrical Stock Market.

On the New York Stock Exchange, General Electric closed the week at 216 bid and 217 asked, showing a gain of 1 point. Metropolitan Street Railway, of New York, closed at 166¾ bid and 167 asked, showing a gain of ¾ point. Brooklyn Rapid Transit closed the week at 82¾ bid and 82⅞ asked, indicating a loss of ¼ point. Third Avenue Railroad closed at 121 bid and 123 asked, showing a loss of 1 point. Manhattan Railway, of New York, closed at 129½ bid and 129⅝ asked, indicating a gain of 2½ points for the week.

On the Boston exchange, American Telephone and Telegraph closed the week at 170 bid and 171½ asked, showing a gain of 3 points. Erie Telephone closed at 50 bid and 50½ asked, showing a gain of 1 point.

On the curb, or outside market, in New York, Electric Vehicle closed at 10½ bid and 12 asked, showing a gain of ½ point for the week.

Wall street, April 4.

Rise in General Electric Stock.

On Tuesday of this week, April 9, the market quotation of the price of the stock of the General Electric Company advanced 12½ points, closing the day at 228. This extraordinary advance was said to be due to the report that the company is about to compensate its shareholders for scaling down the stock a few years ago.

A Combination Volt and Amperemeter for Automobile Service.

A neatly arranged instrument lately brought out by the Keystone Electrical Instrument Company, of Philadelphia, and designed especially for automobile

AUTOMOBILE VOLTAMMETER.

service, possesses numerous points of advantage. It combines an ammeter, which is useful both in charging and in operating the vehicle, and a voltmeter, showing at a glance the condition of the batteries. The instrument is exceedingly compact and convenient in shape, the position of the two scales, which are arranged on one horizontal line, greatly facilitating reading. It is claimed by the makers that these instruments are highly dead-beat and that the mechanical construction of them makes them able easily to withstand hard service. The case is of metal, made light in weight but very strong, and is entirely dust and waterproof. It is finished in black japan.

The amperemeter is of the shunt type, the energy required to operate it being exceedingly small. It is stated by the makers that less than five watts is sufficient when both ammeter and voltmeter are in circuit at full scale. The scales are uniformly divided from zero to the maximum rating, and are very plainly and clearly marked to facilitate rapid reading from the driver's seat.

As will be seen from the accompanying illustration, the shape of the instrument is compact and neat and its appearance ornamental.

Enlargement of the Thresher Electric Company.

The Thresher Electric Company, of Dayton, Ohio, has been incorporated under the laws of the State of West Virginia with an authorized capital of $600,000, for the manufacture and sale of all kinds of electrical machinery and appliances.

This corporation succeeds the company of the same name, of which Mr. Alfred A. Thresher has been the sole proprietor, and which he has incorporated for the purpose of providing more ample facilities for conducting the large and growing business which has been built up during the past eight years under his individual management.

Mr. Thresher is a member of the American Institute of Electrical Engineers, of the Franklin Institute, of Philadelphia, an associate member of the Society of Naval Architects and Marine Engineers and a graduate of Dennison University, where he obtained a thorough grounding in the principles of higher mathematics which are essential to a mastery of his chosen calling of an electrical engineer. After graduation he spent more than a year abroad in travel and observation, and soon after his return established the business which he has prosecuted to the present time, overcoming the obstacles incident to a new enterprise with persistent energy and determination and with signal ability.

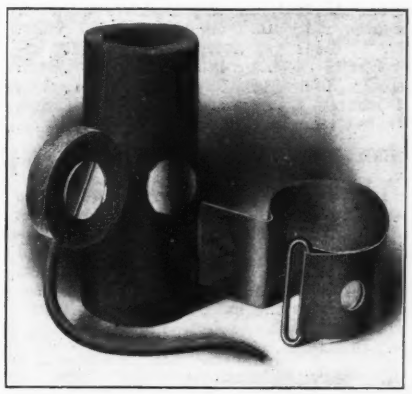


FIG. 1.--PLASTIC ALLOY CLAMP.

In thus adding a leading branch of one of the most prominent of modern industries to the list of Dayton's successful manufacturing enterprises, it has been the aim of Mr. Thresher, in addition to obtaining the discipline and knowledge of details requisite to the conduct of any successful business, also to gain such a grasp of practical mechanical knowledge as well as a personal acquaintance with the requirements of purchasers as would fit him to design and construct the highest grade of electrical machinery.

In entering upon the general market, the Thresher Electric Company offers a complete line of direct-current apparatus for electric railways, lighting and power transmission in three special departments: First. Generators, both direct-connected and belted, of the most approved design, exact in regulation under all degrees of load and economical in operation. Second. A complete system of motors for the transmission and application of electrical power to the varied requirements of industrial uses, including an entirely enclosed type giving very high efficiency, combined with complete protection. Third. Marine generating sets of highest efficiency, designed to meet the severe requirements of the government naval service.

Plans are being prepared for extensive shops with a complete equipment, affording the most approved facilities for manufacturing and testing.

Plastic Alloy Ground Wire Clamps.

The accompanying illustrations represent an ingenious application of the plastic alloy well known hitherto in connection with rail-bonds. The device, as shown in the illustrations, is intended for making earth connections of low resistance which will never rust, for lightning arresters, protection devices, etc., on telephone, telegraph, railway, light or power circuits. It consists of a simple and quick method whereby the wire may be attached directly and permanently to an iron water-pipe or other large earthed conductor. The end of the ground-wire is amalgamated, passed through a hole in the cork disk and bent into a groove in the contact rivet. It is held in place by slipping the disk over the rivet. The shank of the rivet is put into the hole in the retaining

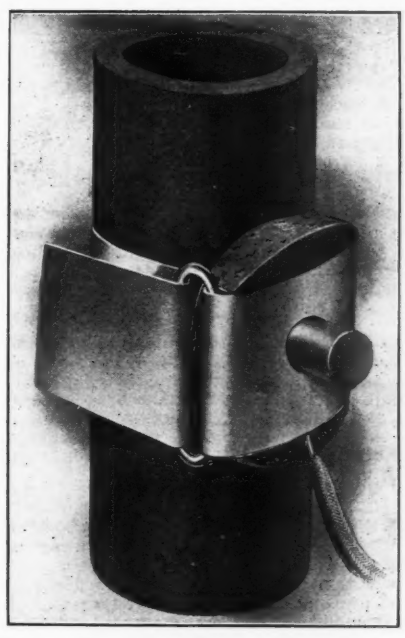


FIG. 2.—PLASTIC ALLOY CLAMP ATTACHED.

band, as is well shown in the illustration. The end of this band is passed through the wire loop and secured by pulling it up with heavy pliers. No solder nor tape is needed. The alloy used is the plastic composition, long known as the Edison-Brown plastic alloy, with which the inventor of this ground clamp, Mr. Harold P. Brown, of New York, has been associated for some time.

Industrial Notes

EDWARDS & COMPANY, New York, manufacturing electricians, announce that they have just completed, for introduction to the trade, a new "Monitor" type bell for street car and telephone service.

THE E. W. BLISS COMPANY, Brooklyn, N. Y., owing to greatly increased European business, has found it necessary to open another branch office in Europe, the new house being situated at 15 Viale Monfort, Milan, Italy.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., states that it is opening up a branch in Cleveland, Ohio, to do a general supply business, and will be pleased to hear from its old friends and customers.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Scranton, Pa., is mailing its official messenger, which is principally devoted to excellent testimonials from former students showing what the work has done for them.

THE OHIO ELECTRIC WORKS, of Cleveland, Ohio, has just issued its new illustrated catalogue containing prices and discounts on the electric novelties and appliances made by that company. A copy will be sent free on application.

THE CONSOLIDATED RAILWAY ELECTRIC LIGHTING AND EQUIPMENT COMPANY, whose general offices are 100 Broadway, New York, has established a branch office in the Rookery, Chicago, Ill., where its general agent, Colonel John T. Dickinson, will be in charge.

THE BROWNING MANUFACTURING COMPANY has moved into a new factory at Milwaukee. The small dynamos and motors of the Browning company are meeting with much success and in the new factory they can be made in sufficient numbers to meet the demands of customers.

THE UNITED STATES CARBON COMPANY, of Cleveland, Ohio, reports an unusual activity for this time of year in the sale of its arc light carbons. It is increasing the capacity of the plant and installing new machinery as the steady growth and demands of the trade tend toward expansion.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, of Chicago, says, through Mr. Henry Shafer, that the demand for central-energy apparatus and multiple-switchboard work is steadily on the increase and the company's shops are kept running to full capacity to keep up with orders.

THE GLOBE AUTOMATIC TELEPHONE COMPANY, of Chicago, factory located at 31 to 45 West Randolph street, offers special terms and inducements for introducing its new automatic telephone system. The system contains particular advantages, and correspondence relating to it is solicited. F. A. Lundquist is manager of this company.

THE GREGORY ELECTRIC COMPANY, 52 to 62 South Clinton street, Chicago, publishes a monthly bargain sheet containing cash prices on dynamos, motors, transformers, instruments, lamps and all kinds of electrical apparatus, which are kept in stock and ready for quick delivery. These bargain sheets can be had on request of parties interested.

THE AMERICAN BRIDGE COMPANY, New York city, announces that it will erect for the Central Railroad of New Jersey, at Weissport, Pa., 12 spans of deck-plate girders 75 feet long, and says that its contracts with that company call for about 28,000 tons of steel work all told. Besides this the company has secured the contract for a large government warehouse at Progreso, Yucatan.

THE GARTON-DANIELS COMPANY, of Keokuk, Iowa, is having a greatly increased demand for its lightning arresters, the sales so far this year being 50 per cent in advance of any previous year. The fine merits of the arrester are well known. The company is enjoying a largely increased sale abroad, where the simplicity and reliability of the lightning arrester are highly appreciated.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is meeting with much success in the sale of a new incandescent lamp called the "Hylo" baby filament lamp, possessing two distinct filaments. The lamps are made in Edison, Thomson-Houston and Sawyer-Man bases and the two filaments give 1 and 16-candle-power light as desired. The change from high to low is by means of slightly turning the lamp in the socket.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., has been having unusual success lately with its high-voltage lamps. These lamps are made to burn on pressures ranging from 200 to 250 volts. Their filament has a triple coil, doubly anchored, and the lamp is stated to be of high efficiency and long life. The company has just secured a large order for these lamps for a new installation in the eastern states.

THE ELECTRIC APPLIANCE COMPANY, 92 West Van Buren street, Chicago, Ill., is mailing a new dodger regarding its telephone signs which have been adopted as the standard by the Iowa Telephone Association. The slip bears a reproduction of the sign, which is made of heavy steel enameled in blue and white with flanges for fastening it to the sides of buildings. Particulars and prices will be mailed upon application to the company.

MOLONEY TRANSFORMERS, built by the Moloney Electric Company, St. Louis, Mo., have been designed with great care so that the iron losses are reduced to a minimum, thus reducing the current consumption on open circuit and making the all-day efficiency of the apparatus when used on constantly operated lighting circuits a maximum. This feature, coupled with the mechanical strength and general electrical excellence of the machines, has made them widely appreciated by central station men and others.

FARR TELEPHONE AND CONSTRUCTION SUPPLY COMPANY, of Chicago, has moved into the large new "Electrical Building," located at 118 and 120 Jackson Boulevard West, and reports trade in telephones to be very heavy. This company has just issued a neat, attractive pamphlet, known as a "Telephone Inspectors' Handbook," containing much valuable information for the construction of telephone lines. It also contains a list of some 300 testimonials from Farr company's customers, showing their appreciation of the telephone apparatus, etc., made by this company.

THE AMERICAN DISTRICT STEAM COMPANY, Lockport, N. Y., manufacturer and contractor for the placing of the Holly system through underground mains for the utilization of direct and exhaust steam, is engaged in building a large plant at Tonawanda, N. Y., to take care of its increasing business. There seems to be a growing interest among electric companies to find some means of utilizing exhaust steam. As this company is said to be the patentee and originator of the idea of underground distribution of exhaust steam for heating purposes, it feels that it is in a position to install such plants in the best manner.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Chicago, Ill., reports the following orders for one week, and states that since the Berliner decision it has experienced a large increase in business: Nelsonville, Ohio, 200 drops; Hartford City, Ind., 400 drops; Mt. Pelier, Ohio, 200 drops; Manning, Iowa, 100 drops; Nicholasville, Ky., 300 drops; Timpsonville, Tex., 150 drops; Logan, Iowa, 200 drops; Bluffton, Ind., 200 drops. The company also states that the central energy switchboard being installed by the Citizens' Telephone Company at Terre Haute, Ind., is rapidly nearing completion.

THE CROCKER-WHEELER COMPANY, of Ampere, N. J., has booked the following orders for the month of March, and was never busier filling orders than at the present time: Philadelphia Engineering Works, 500 horse-power in crane motors. Messrs. Witherbee, Sherman & Company, one, size 150 D, 150-kilowatt, belted type generator, and 160 horse-power in motors. General Electric Company (1900), Ltd., Glasgow, Scotland, one, size 150 D, 150-kilowatt, belted type generator. Newport News Shipbuilding and Dry Dock Company, two, size 15 D, dynamotors; one, size seven and one-half bipolar, dynamotor; one, size 25 D, dynamotor. The New United States Mint at Philadelphia, 19 motors, aggregating 115 horse-power. Newton Street Railway, Newton, Mass., has ordered one, size 448, engine type, 400-kilowatt, railway generator. The Guggenheim Smelting Works, Perth Amboy, N. J., two, size 448, engine type, 520-kilowatt, electrolytic generators. Alsen's American Portland Cement Company, of West Camp, N. Y., three, size 448, engine type, 440-kilowatt, power generators, and one, size 168, engine type, 100-kilowatt, lighting and power generator; also 43 motors, aggregating 2,000 horse-power. Brandywine Traction Company, Brandywine, Pa., one, size 224, engine type, 200-kilowatt, railway generators. John B. Stetson Company, Philadelphia, Pa., two, size 336, engine type, 300-kilowatt, lighting and power generators. Western Union company, 36 machines for telegraphic work.

THE GOULD STORAGE BATTERY COMPANY has brought out a type of automobile storage battery that is believed to be practically revolutionary. The new battery is one of the formed-plate variety, built up of metal that has passed through the "spinning" process used by this company by which the area of a given weight of lead is increased more than twenty-fold. It is claimed that this is done without reducing the strength of the plate and that a plate so constructed is provided with about 20 times the grill surface of the ordinary plate. The surfaces in the Gould plate face one another at a distance of about 10 one-thousandths of an inch so that when the active material grows around the lead plate (it does actually grow, almost like grass growing up out of the ground) the needles of lead shoot out and interlock with one another, forming a sort of fabric in which the fibres of lead are felted together. While the original plate is tough and flexible, on account of being made of pure lead, when the formation is complete it becomes rigid and firm; yet, notwithstanding, retains its original structure and does not become crystalline as sometimes happens with lead plates containing antimony. The fact that no antimony is necessary to insure rigid plates is one of the strongest claims of the Gould company, since its plates are sufficiently rigid even when they are thin. For this reason the battery may be made extraordinarily light for a given output. A comparative test of one of these batteries and another well-known automobile battery, the two being built to occupy the same space and of the same weight, showed 150 ampere-hours capacity for the Gould battery as against 108 for the other, both being rated on a three-hour discharge basis. The test would have been still more favorable had the Gould battery been charged and discharged oftener before testing.